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VIDEO OR INFORMATION PROCESSING METHOD
AND PROCESSING APPARATUS, AND MONITORING METHOD

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1 TECHNICAL FIELD

5 The present invention relates to a man-machine interface with utilizing sound data or video data (simply referred to a "man-machine interface"), and in particular, to a video or information processing method and a processing apparatus for performing a process for an object with employment of sound data or video data of this object, and also to an object monitoring method and a monitoring method with utilizing the processing
10 method/apparatus.

BACKGROUND ART

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To safely operate a large-scaled plant system such as a nuclear (atomic) power plant, an operation monitoring system including a proper man-machine
15 interface is necessarily required. A plant is operatively maintained by way of three tasks "monitor", "judgement", and "manipulation" by an operator. An operation monitoring system must be equipped with such a man-machine interface capable of smoothly achieving these
20 three tasks by an operator. In the "monitor" task, the statuses of the plant are required to be immediately, or accurately grasped. During the "judgement" task, a judging material, and information to be judged must be quickly referred by an operator. During the

1 "manipulation" task, such a task environment is neces-
sarily required in which an object to be manipulated and
a result of the manipulation can be intuitively grasped,
and also the manipulation intended by the operator can be
5 quickly and correctly performed.

The man-machine interface of the conventional
operation monitoring system will now be summarized with
respect to each of the tasks "monitor", "judgement", and
"manipulation".

10 (1). Monitor

Conditions within a plant may be grasped by
monitoring both of data derived from various sensors for
sensing pressure and temperatures and the like, and video
derived from video cameras positioned at various places
15 of the plant. Values from the various sensors are
displayed on a graphic display in various ways. Also, a
trend graph and a bar graph are widely utilized. On the
other hand, the video derived from the video camera may
be displayed on an exclusively used monitor separately
20 provided with the graphic display. More than 40 sets of
cameras are installed in a plant, which is not a rare
case. While switching the cameras, and controlling the
lens and directions of the cameras, an operator monitors
various places in the plant. In the normal monitoring
25 task, there is a very rare case that pictures or video
derived from the cameras are observed by the operator,
and it is an actual case that a utilization factor of the
pictures derived from the cameras is low.

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1 (2). Judgement

If an extraordinary case happens to occur in a plant, an operator must immediately and accurately judge what happens to occur in the plant by extensively
5 checking a large amount of information obtained from sensors and cameras. Since the data derived from the various sensors and the pictures or video from the cameras are independently supervised or managed in the present operation monitoring system, it is difficult to
10 refer these data and pictures with giving relationships to them, resulting a heavy taskload on the operator.

(3). Operation

Operations are done by utilizing buttons or levers provided on an operation panel. Recently, there
15 have been proposed such systems that an operation is performed by combining a graphic display with a touch panel, and by selecting menus and figures displayed on a screen. However, the buttons and levers provided on the operation panel, and also the menus and figures displayed
20 on the display correspond to abstract forms irrelevant to actual objects. There is such a difficult case that an operator supposes or imagines the functions of these objects and the results of the operations. In other words, there are such problems that an operator cannot
25 immediately understand which lever is pulled to perform a desired operation, or cannot intuitively grasp which operation command is sent to the appliance within the plant when a certain button is depressed. Also, there is

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1 another problem that since the operation panel is
separately arranged with the monitor such as the camera,
the bulky apparatus should be constructed.

The below-mentioned prior art has been proposed
5 to simplify the camera switching operations and the
camera remote control operations with regard to the
monitoring task as described in the above item (1):

(a). Graphics produced by simulating an object to be
photographed by a camera are displayed on a graphic
10 display. A photographic place or position is instructed
on the above-described graphics. In response to this
instruction, the camera is remote-controlled so that a
desired picture is displayed on a monitor of the camera.
This type of plant operation monitoring system is known
15 from, for instance, JP-A-61-73091.

(b). When a process device for performing either an
operation, or a monitoring operation is designated by a
keyboard, a process flow chart of the designated process
device is graphically displayed, and simultaneously a
20 picture of a camera for imaging the above-described
process device is displayed on a screen. Such a sort of
plant operation monitoring system is described in, for
example, JP-A-2-224101.

(c). Based upon a designated position on a monitor
25 screen of a camera for photographing a plant, panning,
zooming and focusing operations of the camera are carried
out. For instance, when an upper portion of the monitor
screen is designated, the camera is panned upwardly,

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1 whereas when a lower portion of the monitor screen is
designated, the camera is panned downwardly. Such a sort
of plant operation monitoring system is described in, for
instance, JP-A-62-2267.

5 On one hand, generally speaking, in a monitor-
ing system such as a process control monitoring system, a
method for visually monitoring conditions of the process
has been employed by installing a monitor apparatus in a
central managing room and an ITV camera (industrial
10 television camera) at the process side and by displaying
situations of the process on a monitor by way of a pic-
ture taken by this camera. This picture and sound are
recorded on a recording medium such as a video tape. In
an extraordinary case, the recording medium is rewound to
15 reproduce this picture and sound.

 On the other hand, data which have been
sequentially sent from the process and are used as a
control (control data), for instance, process data
(measurement data) are displayed on either a monitor or a
20 meter and the like of the central managing room, are
stored in a database within a system, and derived from
the database if an analysis is required, or an extra-
ordinary case happens to occur. This conventional system
is introduced in the plant operation history display
25 method as opened in JP-A-60-93518.

Disclosure of Invention

As described above, the following problems are

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1 provided in the conventional operation monitoring systems:

(1). Since it is difficult to propagate the feeling of attendance in an actual place by way of the remote controls with employment of the keys, buttons and levers provided on the operation panel, and the menu and icon displayed on the monitor screen, the actual object to be operated and the operation result can be hardly and intuitively grasped. Thus, there are many possibilities of error operations.

(2). The operator must directly switches the cameras and also directly perform the remote control operation, and cannot simply select such a camera capable of imaging a desirable scene in case that a large number of cameras are employed to monitor the scene. A cumbersome task is required to observe the desirable scene by operating the camera positioned at a remote place.

(3). There are separately provided the screen to display the picture or video derived from the video camera, the screen from which other data are referred, and the screen, or the apparatus through which the operation is instructed. Accordingly, the problems are such that the resultant apparatus becomes bulky, and the mutual reference between the video image and the other data becomes difficult.

(4). Although a video image of a camera owns a great effect to propagate the feeling of attendance, since this picture has a large quantity of information and also is

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1 not abstracted, there is a drawback that an operator can
hardly and intuitively grasp a structure within the
camera's picture.

On the other hand, in accordance with a graphic
5 representation, an important portion may be emphasized,
an unnecessary portion may be simplified, and then only
an essential portion may be displayed as an abstract.
However, these graphic representations are separated from
the actual object and the actual matter, and therefore
10 there is a risk that an operator cannot readily imagine
the relationship among the graphic representations and
the actual matter/object.

(5). The video information derived from the camera
is entirely, independently managed from other information
15 (for instance, data on pressure and temperatures and the
like), so that the mutual reference cannot be simply
executed. As a consequence, a comprehensive judgement of
the conditions can be made difficult.

On the other hand, the method opened in the
20 above-described JP-A-61-73091 has such a merit that a
desired picture can be displayed by simply designating an
object to be photographed without any complex camera
operations. However, an image related to the picture and
control information cannot be referred by designating a
25 content (appliance and the like being displayed)
represented in the video image. As a consequence, when
an operator finds out an extraordinary portion on a
monitor of a camera and tries to observe this extra-

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5 Also, in accordance with the method described
in JP-A-2-224101, there is an advantage that both of the
graph representation related to the appliance designated
by the keyboard and the camera image can be displayed at
the same time. However, the designation of the appliance
10 cannot be directly performed on the screen. As a con-
sequence, when the operator finds out the extraordinary
portion on the camera monitor and tries to watch this
extraordinary portion more in detail, he must search the
key corresponding to the extraordinary portion on the
15 keyboard.

Moreover, in the method disclosed in JP-A-62-226786, although the operation of the camera can be designated on the screen on which the picture is being displayed without using the input device, e.g., the joystick, such a command as the pan direction, zooming-in and zooming-out of the camera is merely selected. The operator must adjust the camera how much the camera should be panned in order to more easily observe the monitoring object, which implies that this complex operation is substantially identical to that when the joystick is used. Further, since the object to be operated is limited to a single camera, the optimum picture cannot be selected from a plurality of cameras.

1 As described above, in the methods shown in the
respective publications, the information related to the
contents (graphic representations such as picture and
control information) cannot be called out by directly
5 designating the content displayed in the picture (appli-
ances being displayed). As a result, the operator must
find out the information related to the contents being
represented in the picture by himself.

 On the other hand, in the monitoring system
10 such as the above-described process control monitoring
system and the like, since the video information, the
sound (audio) information and the process data are not
mutually related with each other, when they are
reproduced, or analyzed, they must be separately
15 reproduced or analyzed in the prior art. For instance,
when an extraordinary matter happens to occur, this
matter is detected by the measuring device to operate the
buzzer. Thereafter, the corresponding appliance is
searched from the entire process diagram, and this cause
20 and the solving method are determined, so that the
necessary process is executed. In this case, to predict
this cause and the failed device, a very heavy taskload
is required since a large quantity of related data and
pictures are needed. In the analysis with employment of
25 the video, there are utilized the method for checking the
area around the extraordinary portion based on the
process data after the video is previously observed to
search the area near the extraordinary portion, and the

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1 method for reproducing the picture by rewinding the video
after the extraordinary point has been found out by the
process data.

5 However, generally speaking, there are plural
ITV cameras for monitoring the plant and the like.
Since the pictures derived therefrom have been recorded
on a plurality of videos, all of these videos must be
rewound and reproduced until the desired video portion
10 appears in order that the pictures from the respective
cameras are observed with having the relationships
therewith when the extraordinary matter happens to occur,
and the analysis is carried out, which gives a heavy
taskload to the operator.

15 On the other hand, it is difficult to fetch the
desired data from the database, and in most case, after a
large quantity of information has been printed out, the
printed information is analyzed by the operations.

20 As described above, there are the following
problems in the conventional monitoring system such as
the process control monitoring system.

(1). When the video information and the audio
(sound) information are reproduced, since the process
data cannot be referred at the same time, even if the
information is obtained from the picture, cumbersome
25 tasks and lengthy time are required to search the process
data thereafter.

(2). Even when the process data is displayed in the
trend graph or the like, and the time instant when the

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(3). Even when the process data such as the extraordinary value is searched, the cumbersome task is required in order to represent the picture related to this process data.

10 (4). While the recorded process data is displayed, especially, when a large quantity of recorded data are displayed by the fast forwarding mode, the computer is heavily loaded.

(5). Since there is a limitation in the data display method, such demands that the contents thereof are wanted to be observed in detail, and also are wanted to be skipped, cannot be accepted. In particular, when the contents of the data are analyzed by observing them in detail, if the related picture and also sound are referred in the slow reproduction mode, more detailed analysis can be achieved. However, there is no such a function.

(6). There are the operation instructions by the operator as the important element to determine the operation of the process. Since these are not reproduced, no recognition can be made whether or not the conditions of the process have been varied by effecting what sort of the operation.

1 (7). Even when the operator remembers the executed
command, since this command could not be searched,
eventually prediction must be made of the time instant
when the operation instruction is made by analyzing the
5 process data and the like.

(8). As there is no relationship between the process
data and the video information, even if the extraordinary
matter is found out on the picture, only a skilled
operator having much experience can understand what scene
10 is imaged by this picture, and what kind of data is
outputted therefrom. Accordingly, any persons who are
not such a veteran could not recognize which process
device has a relationship with the data.

(9). Since the place to display the video image is
15 separated from the place to represent the process data,
the operator must move his eyes and could not simul-
taneously watch the data and the pictures which are
changed time to time.

(10). There is a problem in the reproducibility
20 of the conventionally utilized video tape with respect to
the quick access of the video data. On the other hand,
if the optical disk is employed, such a quick access may
be possible. However, since the video data becomes very
large, a disk having a large memory capacity is required
25 in order to record the video data.

A purpose of the present invention is to
provide an information processing method and an apparatus
capable of executing a process related to sound (audio)

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1 data, or video (image) data about an object based on this
data.

Another purpose of the present invention is to
provide a video processing method and an apparatus capa-
5 ble of performing a process related to a video image of
at least one object displayed on a screen of display
means based upon information about this object.

A further purpose of the present invention is
to provide a monitoring apparatus capable of relating
10 information for controlling a monitoring object with
sound data, or video data about this monitoring object to
output the related information.

To achieve such purpose, according to one
aspect of the present invention, a video processing
15 apparatus for performing a process related to a video
image of at least one object displayed on a screen of a
display unit, is equipped with a unit for storing
information related to said object and a unit for
performing a process about this object based upon the
20 above information.

In accordance with another aspect of the
present invention, an information processing apparatus
for storing both of data (control data) used for
controlling an object, and also data on a sound or an
25 image related to this object, comprises a unit for
relating the control data with either the sound data or
the video data, and also a unit for relating the contrail
data with the sound data or the video data based upon the

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1 relating unit to be outputted.

Preferably, an aim of the present invention is to solve the above-described problems of prior art, and to achieve at least one of the following items (1) to

5 (6).

(1). In a remote operation monitoring system and the like, an object to be operated and an operation result can be intuitively grasped by an operator.

(2). A picture of a place to be monitored can be
10 simply observed without cumbersome camera operations and cumbersome remote controls of cameras.

(3). The remote operation monitoring system and the like may be made compact, resulting in space saving.

(4). Merits of a camera picture and graphics are
15 independently emphasized, and also demerits thereof may be compensated with each other.

(5). Different sorts of information can be quickly and mutually referred thereto. For instance, a
20 temperature of a portion which is now monitored by way of a camera image can be immediately referred.

(6). A man-machine interface to achieve the above aims can be simply designed and developed.

According to the present invention, the above-described aims (1) to (5) are solved by a method having
25 the below-mentioned steps:

(1). Object Designating Step.

An object within a video image displayed on a screen is designated by employing input means such as a

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1 pointing device (will be referred to a "PD"). The video
image is inputted from a remotely located video camera,
or is reproduced from a storage medium (optical video
disk, video tape recorder, disk of a computer). As the
5 pointing device, for instance, a touch panel, a tablet, a
mouse, an eyetracker, and a gesture input device and so
on are utilized. Before a designation of an object, an
object designatable within a picture may be clearly
indicated by way of a synthesization of a graphics.

10 (2). Process Executing Step.

Based on the object designated by the above-de-
scribed object designating step, a process is executed.
For example, contents of the process are as follows:

* An operation command is sent by which a similar
15 result is obtained when the designated object is operat-
ed, or has been operated. For instance, in case that the
designated object corresponds to a button, such an
operation instruction is sent by which a similar result
can be obtained when this button is actually depressed,
20 or has been depressed.

* Based on the designated object, a picture is
changed. For example, the designated object can be
observed under its best condition by operating a remotely
located camera. By moving a direction of a camera, a
25 designated object is imaged at a center of a picture, and
the designated object is imaged at a large size by
controlling a lens. In another example, it is changed
into such an image of a camera for imaging the designated

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1 object at a different angle, or into an image of a camera
for photographing an object related to the designated
object.

* To clearly display the designated object, a
5 graphics is synthesized with a picture and the synthe-
sized image is displayed.

* Information related to the designated object is
displayed. For example, a manual, maintenance informa-
tion and a structure diagram are displayed.

10 * A list of executable process related to the
designated object is displayed as a menu. A menu may be
represented as a pattern (figure). In other words,
several patterns are synthesized with an image to be
displayed, the synthesized and displayed patterns are
15 selected by way of PD, and then based upon the selected
pattern, the subsequent process is performed.

According to the present invention, the above-
described aim (1) may also be solved by a method having a
step for graphically displaying a control device to
20 control a controlled object on or near the controlled
object represented in a picture.

Also, according to the present invention, the
aim (2) may be solved by a method including a search key
designating step for designating a search key by
25 inputting either a text or a graphics, and a video
searching step for displaying a video image in which an
object matched to the search key designated by the
above-described search key designating step is being

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1 represented.

In accordance with the above-identified aim (6) is solved by a method including an image display step for displaying an image inputted from a video camera, a
5 region designation step for designating a region on the image displayed by the image display step, and a process definition step for defining a process on the region designated by the region designation step.

10 An object in a video picture on a screen is directly designated, and an operation instruction is sent to the designated object. While observing an actually imaged picture of the object, an operator performs an operation instruction. When the object is visually moved in response to the operation instruction, this movement
15 is directly reflected on the picture of the camera. Thus, the operator can execute the remote operation with having such a feeling that he is actually tasking in a field by directly performing operation with respect to the actually imaged picture. As a consequence, the
20 operator can intuitively grasp an object to be operated and also a result of the operation, so that an erroneous operation can be reduced.

Based upon the object in the picture designated on the screen, the cameras are selected and the operation
25 instruction is transferred to the camera. As a consequence, an image suitable for monitoring an object can be obtained by only designating the object within the image. That is to say, the operator merely designates an object

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1 desired to be observed, and thus need not select the
camera but also need not remotely control the camera.

When an operation is directly given to an
object within a picture, a graphics is properly synthe-
5 sized therewith and the synthesized picture is displayed.
For instance, once a user designates an object, such a
graphic representation for clearly indicating which
object has been designated is made. As a result, an
operator can confirm that his intended operation is
10 surely performed. Also in case that a plurality of
processes can be executed with respect to the designated
object, a menu used for selecting a desired process is
displayed. This menu may be constructed by a pattern.
While selecting the pattern displayed as the menu, the
15 operator can have such a strong feeling that he actually
operates the object.

Based on the object within the image designated
on the screen, information is represented. As a conse-
quence, the information related to the object within the
20 image can be referred by only designating the object.
While referring to an image and other information at the
same time, it is easily possible to make a decision on
conditions.

Either a text, or a pattern is inputted as a
25 search key, and then a picture is displayed in which an
object matched to the inputted search key is being
displayed. The text is inputted by way of a character
inputting device such as a keyboard, a speech recognition

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1 apparatus, and a handwritten character recognition
apparatus. Alternatively, the pattern may be inputted by
employing PD, or data which has been formed by other
method is inputted. Also, the text or the pattern
5 located in the picture may be designated as the search
key. In case that the image to be search corresponds to
the image from the camera, based on the search key, the
camera is selected, and furthermore the direction of the
camera and also the lens thereof are controlled, so that
10 the search key can be imaged. It is also possible to
clearly indicate where a portion matched to the search
key is located with the picture by properly synthesizing
the graphics with the image in which the object adapted
to the search key is being represented. As described
15 above, the picture is represented based on the search
key, and the operator merely represents a desirable
object to be seen with a language or a pattern, so that
such a desirable image can be obtained for an observation
purpose.

20 A content of a process to be executed is
defined when an object within a picture has been
designated by displaying the picture, designating a
region on this picture, and defining a process with
respect to the designated region. As a consequence, a
25 man-machine interface for directly manipulating the
object within the picture may be formed.

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1 Brief Description of Drawings

Fig. 1A is a block diagram for explaining a conceptual arrangement of the present invention.

Fig. 1B is a diagram for explaining a
5 relationship among the respective embodiments of the present invention and the conceptual arrangement of Fig. 1A.

Fig. 2 is a schematic diagram for showing an overall arrangement of a plant monitoring system
10 according to one embodiment of the present invention, to which the video or information processing method and apparatus of the present invention has been applied.

Fig. 3 is a diagram for showing one example of a hardware arrangement of the man-machine server shown in
15 Fig. 2.

Fig. 4 is a diagram for indicating a constructive example of a display screen in the plant operation monitoring system of the present embodiment.

Fig. 5 is a diagram for representing an example
20 of a screen display mode of a figure display region of a display screen.

Fig. 6 is a diagram for showing a relationship between a field and a screen display mode of the picture display region.

25 Figs. 7A and 7B illustrate one example of a camera parameter setting operation by designating the object.

Figs. 8A and 8B show an example of a camera

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1 parameter setting operation by designating the object.

Fig. 9 represents one example of a button operation by designating the object.

Fig. 10 indicates an example of a slider operation by designating the object.

Figs. 11A and 11B show one example of operations by selecting the respective patterns.

Fig. 12 is a diagram for showing an example of clearly indicating an operable object.

10 Fig. 13 is a diagram for indicating an example of a picture search by a search key.

Fig. 14 illustrates an example of a three-dimensional model.

Fig. 15 is a diagram for indicating a relationship between the three-dimensional model and the picture displayed on the screen.

Fig. 16 is a diagram for showing a relationship between an object and a point on a screen.

Fig. 17 is a flow chart for showing a sequence of an object identifying process with employment of the three-dimensional model.

Fig. 18 is a flow chart for indicating a sequence of a realizing method according to the embodiment.

25 Figs. 19A and 19B are diagrams for showing a relationship between a two-dimensional model and a camera parameter.

Figs. 20A and 20B are diagrams for indicating a

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1 relationship between the two-dimensional model and
another camera parameter.

Figs. 21A and 21B are diagrams for representing
a relationship between the two-dimensional model and a
5 further camera parameter.

Fig. 22 is a diagram for showing a sequence of
an object identifying process with employment of the
two-dimensional model.

Fig. 23 illustrates a structure of a camera
10 data table.

Fig. 24 represents a structure of a camera data
table.

Fig. 25 indicates a data structure of a region
frame.

15 Fig. 29 is a diagram for indicating an arrange-
ment of a monitoring system according to another
embodiment of the present invention.

Fig. 30 is a diagram for showing a constructive
example of a work station shown in Fig. 29.

20 Fig. 31 is a diagram for representing an
constructive example of a picture/sound recording unit.

Fig. 32 is an explanatory diagram of one
example of a display screen.

Fig. 33 is an explanatory diagram of one
25 example of a trend graph represented on the display.

Fig. 34 is an explanatory diagram of a display
representation according to a further embodiment of the
present invention.

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1 Figs. 35A and 35B are explanatory diagrams of a
video controller for determining the reproducing direc-
tion and speed of the picture and sound.

 Figs. 36A to 36G are explanatory diagrams for
5 showing data structures such as process data and video
data used in a further embodiment.

 Fig. 37 is a flow chart for representing
examples of operations to record the picture and sound on
the picture/sound recording unit.

10 Fig. 38 is a flow chart for showing an example
of an operation to display the recorded picture.

 Fig. 39 is a flow chart for indicating an
example of an operation to realize a further embodiment
of the present invention.

15 Fig. 40 is an explanatory diagram for showing a
display representation according to another embodiment of
the present invention.

 Fig. 41 is a flow chart for showing an example
of an operation to realize another embodiment of the
20 present invention.

 Fig. 42 is an explanatory diagram for indicat-
ing a display representation according to another
embodiment of the present invention.

 Fig. 43 is a flow chart for showing an example
25 of an operation to realize another embodiment of the
present invention.

 Fig. 44 is an explanatory diagram of a display
representation in accordance with another embodiment of

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1 the present invention.

Fig. 45 is an explanatory diagram of a display representation according to another embodiment of the present invention.

5 Fig. 46 is a flow chart for representing an operation example to realize another embodiment of the present invention.

Fig. 47 is an explanatory diagram of a display representation in accordance with another embodiment of
10 the present invention.

Fig. 48 is a flow chart for showing an operation example to realize another embodiment of the present invention.

Fig. 49 is an explanatory diagram of a display representation in accordance with another embodiment of
15 the present invention.

Fig. 50 is an explanatory diagram of a display representation in accordance with another embodiment of the present invention.

20 Fig. 51 is an explanatory diagram of a display representation in accordance with another embodiment of the present invention.

Fig. 52 is an explanatory diagram of a display representation in accordance with another embodiment of
25 the present invention.

Fig. 53 is an explanatory diagram of a display representation in accordance with another embodiment of the present invention.

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1 Fig. 54 is an explanatory diagram of a display
representation in accordance with another embodiment of
the present invention.

5 Fig. 55 is an explanatory diagram of a display
representation in accordance with another embodiment of
the present invention.

 Fig. 56 is an explanatory diagram of a display
representation in accordance with another embodiment of
the present invention.

10 Fig. 57 is an explanatory diagram of a display
representation in accordance with another embodiment of
the present invention.

 Fig. 58 is an explanatory diagram of a display
representation in accordance with another embodiment of
15 the present invention.

 Fig. 59 is an explanatory diagram of a display
representation in accordance with another embodiment of
the present invention.

20 Fig. 60 is an explanatory diagram for showing a
method for determining to select an object within a
control unit in accordance with another embodiment of the
present invention.

Best Mode for carrying out The Invention

25 Before describing an embodiment of the present
invention, a concept of the present invention will now be
explained with reference to Fig. 1A. It should be noted
that Fig. 1B represents a relationship between a

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1 constructive element of this conceptional diagram and
constructive elements of first and second embodiments.

5 In Fig. 1A, an object information storage unit
stores information related to various sorts of appa-
ratuses (objects) (positions of apparatuses, shape
information, control information, manual information,
design information etc.) within a plant, which are being
imaged in a video image outputted by a video output unit
(video imaging/recording/reproducing unit). It should be
10 noted that any appliances and apparatuses to be operated
and monitored will be referred to as an "object" hereinafter.
A video output unit outputs a picture (video)
under taking a picture with a plant and also a picture
being recorded in the past. A graphics generating unit
15 outputs a systematic diagram of a plant, control information
of each object, manual information as graphics and
so on. The graphics output from the graphics generating
unit is synthesized with a video output from the video
output unit by a video/graphics synthesizing unit, and
20 then the synthesized output is displayed on a display
unit. When a position on a display unit is designated by
a screen position designating unit, an object
identification/process executing unit identifies an
object displayed on the above-described designated
25 position on the display unit based on both of object
information stored in the object information storage
unit and the above-described designated position.
Subsequently, the object identification/process executing

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1 unit executes a process corresponding to the above-
explained identified object. For instance, a picture
related to the above-described identified object is
displayed on the display unit by controlling the video
5 output unit, the control information concerning the
object is derived from the object information storage
unit, and the above-described derived information is
graphically displayed on the display unit by controlling
the graphics generating unit.

10 That is to say, the object information storage
unit in Fig. 1A stores therein information about an
object displayed on the screen of the display unit, and a
portion surrounded by a dot and dash line executes a
process related to this object based upon the stored
15 information (for instance, a process to identify the
information in the object information storage unit, which
corresponds to the information designated by the screen
position instruction unit, and a process for displaying
graphics based upon this information).

20 The information related to the object indicates
graphic information, positional information and the like
related to an object in the first embodiment, and also
represents control data (control data, or control
information) related to an object, sound or video data
25 related to an object, and furthermore information
concerning the control data and the sound, or video data
in the second embodiment.

Also, the portion surrounded by the dot and

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1 dash line in Fig. 1A establishes a relationship between
the control data and the sound or video data based upon
the above-described relating information in the second
embodiment.

5 Referring now to drawings, embodiments of the
present invention will be explained. First, a plant
operation monitoring system corresponding to one
embodiment (first embodiment) of the present invention,
to which the video or information processing method and
10 apparatus of the present invention have been applied with
employment of Figs. 2 to 28.

An overall arrangement of this embodiment is
explained with reference to Fig. 2. In Fig. 2, reference
numeral 10 denotes a display functioning as a display
15 means for displaying graphics and video; reference
numeral 12 shows a pressure sensitive touch panel
functioning as an input means mounted on an overall
surface of the display 10; reference numeral 14 is a
speaker for outputting a sound; reference numeral 20
20 indicates a man-machine server used to monitor and
operate the plant by an operator; and reference numeral
30 is a switcher for selecting one video input and one
sound input from a plurality of video inputs and also a
plurality of sound inputs. In Fig. 2, reference numeral
25 50 shows a controlling computer for controlling
appliances within the plant, and for acquiring data
derived from sensors; reference numeral 52 shows an
information line local area network (will be referred to

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1 a "LAN" hereinafter) for connecting the controlling
computer 50, the man-machine server 20, and other
terminals/computers (for example, a LAN as defined under
IEEE 802.3). Reference numeral 54 denotes a control line
5 LAN for connecting the controlling computer 50, various
sorts of appliances to be controlled and various sensors
(for example, a LAN as defined by IEEE 802.4); reference
numerals 60, 70 and 80 industrial video cameras (simply
referred to an "ITV cameras" hereinafter) mounted on
10 various places within the plant, imaging an object to be
controlled and inputting an imaged object; reference
numerals 62, 72, 82 denote controllers for controlling
directions and lenses of the respective cameras 60, 70
and 80 in response to an instruction from the controlling
15 computer 50. Reference numerals 64, 74 and 84 show
microphones mounted on the respective cameras 60, 70, 80;
reference numerals 90 and 92 indicate various sensors
used to recognize various states of the plant; and
reference numerals 84 and 96 represents actuators for
20 controlling the various appliances in the plant in
response to the instruction of the controlling computer
50.

The pressure sensitive touch panel 12 is a sort
of PD. When an arbitrary position on the touch panel 12
25 is depressed by a finger of an operator, both of a coor-
dinate of the depressed position and depressed pressure
are reported to the man-machine server. The touch panel
12 is mounted on the entire surface of the display 10.

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1 The touch panel 12 is transparent, and a display content
of the display 10 positioned behind the touch panel 12
can be observed. As a result, an operator can designate
an object displayed on the display 10 with having the
5 feeling of finger touch. In this embodiment, three sorts
of operations are employed as the operations of the touch
panel 12, i.e., (1) to lightly depress, (2) to strongly
depress, and (3) to drag. Dragging the touch panel 12
implies that the finger is moved while depressing the
10 touch panel 12 by the finger. Although the pressure
sensitive touch panel has been employed as PD in this
embodiment, other devices may be employed. For instance,
a not-pressure sensitive type touch panel, a tablet, a
mouse, a light pen, an eye trucker, a gesture input
15 device, a keyboard may be utilized.

A plurality of video images taken by the
cameral 60, 70 and 80 are selected to be a single picture
by the switcher 30, which will then by displayed via the
man-machine server 20 on the display 10. The man-machine
20 server 20 controls via a communication port such as RS
232C the switcher 30, and selects a picture from the
desirable camera. In this embodiment, upon selection of
a picture, a sound inputted from the microphones 64, 74
and 84 are selected at the same time. In other words,
25 when a camera is selected the microphone attached to this
selected camera is switched to be operated. A sound
inputted into the microphone is outputted from the
speaker 14. It is of course possible to separately

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1 select an input from the microphone and an input from the
camera. The man-machine server 20 may synthesize the
graphics with the picture derived from the camera.
Also, the man-machine server 20 transmits an operation
5 command to the controlling computer via the information
LAN 52 so as to designate an imaging direction, attitude,
an angle of view, a position of a camera. It should be
noted that parameters related to a camera such as the
imaging direction, attitude, angle of view and position
10 will be referred to camera parameters.

Furthermore, the man-machine server inputs the
data from the sensors 90 and 92 via the controlling
computer 50 in accordance with an instruction of an
operator, and remote- controls the actuators 94 and 96.

15 An arrangement of the man-machine server will
now be explained with reference to Fig. 3. In Fig. 3,
reference numeral 300 indicates a CPU (central processing
unit); reference numeral 310 denotes a main memory;
reference numeral 320 shows a disk; reference numeral 330
20 is an input/output device (I/O) for connecting the PD,
touch panel 12 and switcher 30; reference numeral 340
denotes a graphics frame buffer for storing display data
produced by the CPU 300; reference numeral 360 indicates
a digitizer for digitizing analog video information which
25 is inputted. Furthermore, reference numeral 370 shows a
video frame buffer for storing therein the digitized
video information corresponding to the output from the
digitizer 360; reference numeral 380 indicates a blend

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1 circuit for blending the content of the graphics frame
buffer 340 and the content of the video frame buffer 370
and for displaying the blended contents on the display
10.

5 After the video information inputted from the
camera has been synthesized with the graphics produced
from the man-machine server 20, the resultant video
information is displayed on the display 10. In the
graphic frame buffer 34, there are stored color data for
10 red (R), green (G) and blue (B) and data referred to an
 α value in accordance with the respective pixels on the
display 10. The α value instructs how to synthesize the
video information stored in the video frame buffer 370
with the graphic display data stored in the graphic frame
15 buffer 34 with respect to the respective pixels of the
display 10. The function of the blend circuit 380 is
expressed by as follows:

$$d = f (g, v, \alpha)$$

where symbols "g" and " α " indicate color information and
an α value of one pixel stored in the graphic frame
20 buffer 340, symbol "v" shows color information of a pixel
located at a position corresponding to the color infor-
mation "g" stored in the video frame buffer 370, and
symbol "d" is color information of a pixel of the
synthesized color information "g" and "v". In this
25 system, the following equation is employed as the

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1 function "f":

$$f(g, v, \alpha) = [\{ g + (255-\alpha)V\}/255],$$

where symbols f, g, v, α are an integer, and $0 \leq f, g, v, \alpha \leq 255$. A blank [] indicates a symbol for counting fractions over 1/2 as one and disregarding the rest with
5 respect to a number less than a decimal point. It is of course possible to employ other values as the function "f".

The graphic frame buffer 340 is constructed of a so-called "double buffer". The double buffer owns
10 buffers used to store two screen image data, and the buffer displayed on the display 10 is arbitrarily selected. One buffer displayed on the display 10 will be referred to a front buffer, whereas the other buffer not displayed on the display 10 will be referred to a rear
15 buffer. The front buffer and the rear buffer can be instantaneously changed. The graphics is represented in the front buffer, when the graphic representation is accomplished, the rear buffer is changed into the front buffer so as to reduce fluctuation occurring in the
20 graphic representation. The content of either buffer maybe arbitrarily read out and written by the CPU.

As described above, after the video information has been digitized within the man-machine server 20, the digitized video information is synthesized with the
25 graphics in this embodiment. Alternatively, an external

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1 apparatus for synthesizing both of the video information
and the graphics at the level of the analog signal is
employed, and the video signal outputted from the man-
machine server 20 is synthesized with the television
5 signal derived from the camera 60, and the synthesized
signal may be displayed on the display 10. An apparatus
(will be referred to a video synthesizing apparatus) for
synthesizing a computer such as the man-machine server 20
with the television signal derived from the camera 60 is
10 commercially available.

Although the graphics and the video are
displayed on the same display (display 10) in this
embodiment, these graphics and video may be represented
on separate display units. For instance, a graphic
15 terminal is connected via the information line LAN 52 to
the man-machine server 20, and the video information
derived from the camera is displayed in a full screen
with employment of the above-described video synthesizing
apparatus. The graphics generated from the man-machine
20 server 20 is mainly displayed on the display 10. To the
graphic terminal, a pointing device such as a touch
panel, or a mouse similar to the pressure sensitive touch
panel 12 is mounted. In accordance with a predetermined
protocol, the man-machine server 20 outputs the graphic
25 information to the graphic terminal, so that the graphics
can be superimposed and displayed on the video displayed
on the graphic terminal. As described above, since the
video information is represented on the graphic terminal

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1 separately provided with the display 10, much graphic
information may be displayed on the display 10.

In Fig. 4, there is shown one example of a
display screen arrangement of the display 10. In Fig. 4,
5 reference numeral 100 denotes a display screen of the
display 10; reference numeral 110 shows a menu region for
designating a command related to an overall system;
reference numeral 150 represents a data display region
for displaying the data from the sensors, various
10 documents and data related to the plant; reference
numeral 130 is a drawing display region for displaying
arrangement constructive, and design drawings of the
overall plant and the respective portions of the plant;
and reference numeral 200 is a video display region for
15 displaying the video or picture inputted from the camera.

Fig. 5 shows one example of display modes of
the drawing display region 130. In Fig. 5, reference
numeral 132 shows a menu for issuing a command used to
clarify a place where a sensor is installed, and
20 reference numeral 134 denotes one object shown on a
drawing designated by an operator. When the object
within the drawing displayed in the drawing display
region 130 is selected by the operator, the information
about this selected object, derived from the sensor is
25 represented on either the data display region 150, or the
video display region 200. For example, when a camera is
defined as a sensor related to the designated object, a
picture inputted from this camera is displayed in the

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1 video display region 200. Also, for instance, in case
that an oil pressure sensor is defined as a sensor
related to the designated object, either a graphics for
clearly displaying the present oil pressure value, or a
5 trend graph indicative of variations in the oil pressure
values which have been measured up to now is displayed in
the data display region 150. If a position on the touch
panel 12 is strongly depressed by a finger, an object
displayed on the drawing, which is represented at the
10 depressed position is designated. If no definition is
made of the sensor related to the designated object,
nothing happens to occur. In Fig. 5, there is shown that
the display position of the object 134 is strongly
depressed by the finger. When the object is depressed by
15 the finger, the representation is emphasized in order
that the designation of the object can be recognized by
the operator. In the example shown in Fig. 5, both of
the camera 60 for imaging the object 134 and the
microphone 64 for entering sounds around the object 134
20 have been defined as the relevant sensors in the object
134. Upon designation of the object 134, an image of the
object 134 is displayed on the video display region 200
and the sounds around the object 134 are outputted from
the speaker 14.

25 In Fig. 6, there are shown one display mode of
the video display region 200 when the object 134 is
designated on the drawing display region 130, and also a
relationship between this display mode and the object 134

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- 1 positioned in the plant. In Fig. 6, reference numerals
202 to 210 indicate means for setting a camera parameter
of a camera which photographs or takes a picture of a
presently displayed picture; and reference numeral 220
5 denotes a menu for clearly indicating an object suitable
in the picture. Reference numeral 202 is a menu for
setting a direction of a camera. When the menu 202 is
selected, the camera may be panned in right and left
direction, and may be panned in upper and lower
10 directions. Reference numeral 204 shows a menu for
controlling an angle of view of a camera to zoom-in a
picture. Reference numeral 206 shows a menu for control-
ling the angle of view of the camera to zoom-out the
picture. Reference numeral 208 indicates a menu for
15 correcting the present camera parameter to substitute it
by the camera parameter set during one step before.
Reference numeral 210 is a menu for correcting the
present camera parameter to substitute it by the first
camera parameter.
- 20 Reference numerals 400 to 424 indicate various
sorts of objects which belong to the object 134, or are
located around this object. Reference numeral 400
denotes a valve; reference numerals 400 and 420 show
character representation written on the object 134;
25 reference numeral 412 is a meter to indicate a voltage;
reference numeral 414 denotes a button to turn on a power
source; reference numeral 416 shows a button to turn off
the power source; reference numeral 422 is a meter

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1 indicative of oil pressure; and reference numeral 424
indicates a knob of a slider for controlling oil
pressure. The valve 400, buttons 414, 416 and knob 424
correspond to actually manually-operable control devices,
5 and also such control devices remote-controlled in
response to the operation command issue from the man-
machine server 20.

When an operator lightly depress a position
within the video display region 200 by his finger, the
10 camera task is set in such a manner that the object
displayed on the position depressed by the finger can be
easily observed. In Figs. 7A and 7B, there are shown
such a condition that the camera parameter is set in such
a way that when the meter 412 is slightly touched by the
15 finger at the video display region 200, the meter 412 is
positioned at a true center of the picture. When the
meter 412 is designated by the operator as represented in
Fig. 7A, the direction of the camera 60 is set in such a
manner that the meter 412 is imaged at the center of the
20 picture, and furthermore the lens of the camera 60 is
controlled in a way that the meter 412 is zoomed in, and
then the picture is changed into Fig. 7B. Only when the
operator merely touches the object on the screen, the
camera parameter can be set in such a manner that this
25 object can be clearly observed, and the operator is not
bothered by the remote control of the camera. In Fig.
7A, reference numeral 502 shows a graphic echo for
clearly indicating that the meter 412 has been desig-

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1 nated. The graphic echo 502 is erased when the finger of
the operator is released, or separated from the touch
panel 12. As described above, the man-machine interface
can be improved by synthesizing the graphic
5 representation with the picture of the camera.

Figs. 8A and 8B represent such a condition that
when the valve 400 is lightly touched by the finger
within the video display region 200, the camera task is
set in such a manner that the valve 400 is located at a
10 center of the picture. When the valve 400 is designated
by the operator as shown in Fig. 8A, the picture is
changed in such a way that the center of the picture
shown in Fig. 8B. In Fig. 8A, reference numeral 504
denotes a graphic echo for clearly displaying that the
15 valve 400 is designated. The graphic echo 504 is erased
when the finger of the operator is released from the
touch panel 12. Also, with respect to other objects 410,
414, 416, 420, 422 and 424, similar operations may be
applied.

20 If a position within the video display region
200 is strongly depressed by an operator, an object
displayed at the position of the finger may be operated.
In Fig. 9 to Fig. 11, there are shown examples where
objects are operated.

25 Fig. 9 represents an example in which the
button 414 is operated. When the position on the video
display region 200, in which the button 414 is displayed,
is strongly depressed by the finger, such an operation

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1 instruction that the button 414 is depressed is trans-
ferred from the man-machine server 20 via the controlling
computer 50 to the actuator for actuating the remote-
located button 414, and then the button 414 present at
5 the remote field is actually depressed. A situation that
the button 414 is depressed and as a result, a pointer of
the meter 412 is swung, is displayed in the video display
region 200 by the camera 60. As a consequence, the
operator can obtain on the video screen such a feeling
10 that the button is actually depressed.

Fig. 10 represents such an example that the
knob 422 of the slider is manipulated by the drag of the
finger on the touch panel 12. When the finger is moved
along the horizontal direction while strongly depressing
15 the position where the button 414 is displayed on the
video display region 200, the knob 424 being displayed on
the picture is moved in conjunction with the movement of
the finger. As a result of movement of the knob 424, the
pointer of the meter 422 is swung. At this time, the
20 man-machine server 20 sends out an instruction via the
controlling computer 50 to the actuator for controlling
the knob 424 every time the finger is moved, so that the
knob 424 is actually moved in conjunction with movement
of the finger. As a consequence, the operator can obtain
25 such a feeling that the knob 424 is actually manipulated
by his finger.

As represented in Figs. 9 to 10, advantages
that the operator devices 414 and 412 being displayed in

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1 the picture are directly manipulated on the picture is
given as follows:

(1). An operator can have such a feeling that he is
located at a field, while he is present at an operation
5 room. A picture can directly transmit an arrangement an
atmosphere (shape, color and so on) of the device. As a
consequence, prediction, learning and imagination can be
readily achieved with respect to the functions of the
respective appliances and the results of the operations
- 10 there of. For instance, if the button 414 is depressed
in Fig. 9, it may be easily predicted that the power
source of the appliance 134 is turned on.

(2). An observation by an operator can be done what
happens at a field as a result of operation made by the
15 operator. For instance, when the button 414 is
depressed, if smoke appears from the appliance 134, an
operator can immediately observe this smoke, and can
become aware of his misoperation.

In accordance with the conventional graphical
20 man-machine interface, control devices are graphically
represented. When the graphic representation is
performed, since abstract, simplification, and exag-
geration are carried out, it becomes difficult to
establish a relationship between the actual devices and
25 the graphic representations. Since the size of the
display screen is limited to a certain value, the
graphics is arranged irrelevant to the actual arrange-
ments of the devices. As a consequence, an operator can

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1 hardly, intuitively grasp how to control the devices in
the field by operating the graphic operator. Since the
operation results are graphically displayed, it is
difficult to intuitively grasp the extraordinary case.

5 Fig. 11A represents an example in which an
object is operated by operating a graphics displayed on,
or near the object to be operated in a synthesized form.
In Fig. 11A, reference numerals 510 and 520 indicate
graphics represented in a synthesized form on the picture
10 when the display position of the valve 400 is strongly
depressed by a finger of an operator. When the operator
strongly depressed a pattern 51 by his finger, the man-
machine server 20 send out an operation instruction via
the controlling computer 50 to the actuator to rotate the
15 valve 400 in the left direction. Conversely, when the
graphics 512 is strongly depressed by the finger, the
man-machine server transfers an operation command to the
actuator to turn the valve 400 in the right direction.
A situation of rotations of the valve 400 is imaged by
20 the camera 60 to be displayed on the video display region
200. In conjunction with rotations of the valve 400,
representations of the graphics 510 and 512 may be
rotated. The graphics displayed on the screen for
manipulation, as represented in the patterns 510 and 512,
25 will now be referred to a "graphic control device",
respectively.

Another example of the graphic control device
is shown in Fig. 11B. In Fig. 11B, reference numeral 426

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1 shows a pipe connected to a lower portion of the object
134; reference numeral 800 denotes a slider displayed as
the graphics on the picture in the synthesized form;
reference numeral 810 indicates a knob of the slider 800;
5 and reference numeral 428 shows a variation in a flow
rate within the pipe 426 which is displayed as the
graphics on the pipe 426 in the synthesized form. When
the pipe 426 is strongly depressed on the video display
region 200 by the operator, the slider 800 is displayed
10 near the pipe 426 in the synthesized form. Furthermore,
the graphics 428 indicative of the present flow rate of
the pipe 426 is displayed on the pipe 426 in the
synthesized form. The graphics 428 will change, for
instance, a width and color thereof in response to the
15 flow rate within the pipe 426. When the flow rate
becomes high, the width of the graphics becomes wide,
whereas when the flow rate becomes low, that of the
graphics become narrow. When the knob 810 of the slider
800 is dragged by his finger of the operator, an
20 instruction to control the flow rate within the pipe 426
in response to the movements of the knob 810 is trans-
ferred from the man-machine server 20 to the controlling
computer 50. Furthermore, the operation command is
issued from the computer to the actuator, for instance,
25 the pump, and this pump is controlled. As a result, when
the flow rate within the display condition of the
graphics 428 is changed in response to this variation.

As shown in Figs. 11A and 11B, advantages that

1 the graphic control device is displayed on, or near the
appliance imaged on the monitor picture in the synthe-
sized form, is given as follows:

(1). A hint is given to an operator by the graphic
5 control device which appliance actually controlled
corresponds to which device present in a field. In the
example of Fig. 11A, the operator can simply and easily
predict and also remember that the graphic control
devices 510 and 512 control the valve 400 displayed in
10 the synthesized form. In the example of Fig. 11B, it is
easily conceived that the slider 1800 controls the flow
rate within the pipe 426 which is photographed near this
slider 1800.

(2). An operation can be carried out while observing
15 a condition of an appliance to be controlled. In the
example of Fig. 11B, if a crack is made in the pipe 426
and a fluid is leaked therein during operations of the
graphic control device 1800, an operator can recognize it
by his eyes, and can immediately recognize such an error
20 operation and also such an extraordinary case.

In the conventional graphic man-machine
interface, since the graphic control device is arranged
on the screen irrelevant to the appliances in the field,
it is difficult to recognize which appliance in the
25 actual field is controlled by the graphic control device.
Also, since the place where the graphic control device is
displayed is positioned apart from the place where the
monitored picture of the field is displayed, an operator

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1 must move his eyes several times in order to execute the
operations while observing the situations of the field.

In Fig. 11B, there is shown that the flow rate
of the pipe 426 is indicated by representing the
5 graphics 426 on the picture of the pipe 426 in the
synthesized form. As described above, the graphics is
synthesized on the appliance which is being displayed in
the picture, so that information such as internal con-
ditions of the appliance which is not displayed in the
10 picture can be supplemented. As a consequence, for
instance, both of the internal situation of the appliance
and the external situation thereof can be referred at the
same time, the entire situations of the appliance can be
comprehensively monitored and judged.

15 Fig. 12 represents a method for clearly
indicating an operable object. Since all of objects
represented in a picture are not always operable, a means
for clearly indicating operable objects is required. In
Fig. 12, when a menu 220 is lightly or softly touched by
20 a finger, graphics 514 to 524 are represented. The
graphics 514 to 524 clearly indicate that the objects
400, 412, 414, 416, 422 and 424 are operable, respec-
tively. In case of the present embodiment, an exploded
rectangle of an object is represented. It is of course
25 possible to conceive other various display methods in
order to clearly indicate the object such as graphic
representations of real objects.

Furthermore, a means for clearly indicating not

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1 only such operable objects, but also any objects may be
employed. For instance, when the menu 220 is strongly
depressed by the finger, all of the objects being repre-
sented in the picture may be clearly indicated. The
5 above-described object clearly indicating means can
clearly indicate the operable objects, but also can
represent the operation and the cause of failure even
when, for instance, a substance to disturb a view field,
such as smoke and steam happens to occur. Since even if
10 the object to be operated is covered with the smoke, the
object to be operated is clearly indicated by the
graphics, operation can be performed. Also, since it can
be seen where and which appliance is located, a place
where the smoke is produced can be found out.

15 In Fig. 13, there is shown an example in which
a text is inputted and a search is made in a picture
where this text is displayed. In Fig. 13, reference
numeral 530 denotes a graphics displayed on a picture in
a synthesized form; reference numeral 600 indicates a
20 search sheet for executing a text search; reference
numeral 610 shows a next menu for searching another
adaptable picture by the search key; reference numeral
620 is an end menu for designating an end of a search;
and reference numeral 630 denotes a text input region for
25 inputting to the search key. When a selection is made of
designating a search in the menu region 110, the search
sheet 600 is displayed on the display screen 100. When a
text corresponding to the search key is entered from the

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1 keyboard into the text input region 630 and the return
key is depressed, the search is commenced. The man-
machine server searches such a camera capable of photo-
graphing a matter containing the search key, sets the
5 searched camera to such a camera task that the search key
can be clearly seen, and displays the picture derived
from the searched camera on the video display region 200.
The graphics 530 is displayed in the synthesized form on
the portion matched to the search key within the picture,
10 and the portion matched to the search key within the
picture, and the portion matched to the search key is
clearly indicated. The object to be monitored can be
pictured by the operator with his language by the picture
search where the text is used as the search key.
15 According to this method, the object to be monitored can
be quickly found out by not changing the cameras and not
controlling the cameras in the remote control manner.
In this embodiment, the keyboard is employed to input the
text. Alternatively, other input means such as a speech
20 recognition apparatus, and a hand-writing character
recognition apparatus may be utilized. Although the text
is utilized as the search key in this embodiment, a
pattern is employed as the search key and such a picture
that a pattern matched to the pattern of the search key
25 is represented may be searched.

A realizing method of this embodiment will now
be explained with reference to Figs. 14 to 25. A major
function of this embodiment is such a function that an

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1 object within a picture is designated and an operation
based on this object is executed. A flow chart of a
program to realize this function is represented in Fig.
18. When the touch panel 12 on the video display region
5 200 is depressed, an object imaged at this depressed
position (a position on a screen designated by an
operator by use of a PD such as a touch panel will be
referred to an "event position") is identified (step
1000). When the object can be identified (in case that
10 the object is present at the event position) (step 1010),
an operation defined in accordance with this object is
executed (step 1020).

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The object pictured at the event position is
identified with reference to the model of an object to be
15 photographed and a camera parameter. The model of an
object to be photographed corresponds to the shape of an
object to be photographed and data about the position
thereof. The model of an object to be photographed is
stored in the disk 320 of the man-machine server 20, and
20 read into the main memory 310 when the plant operation
monitoring system is operated. The camera parameter
implies how to photograph an object to be photographed by
a camera, namely data about a position of a camera, an
attitude, an angle of view, and a camera direction. A
25 value of a camera parameter which has been set to a
camera may be recognized if an interrogation is made to a
camera controlling controller. Of course, the camera
parameter may be supervised by the man-machine server 20.

1 In other words, a region for storing the present value of
the camera parameter is reserved in the main memory 310
of the man-machine server 20, and the values of the
camera parameter stored in the main memory 310 are
5 updated every time the camera is remote-controlled by the
man-machine server 20. The parameters of all cameras are
initialized by the man-machine server 20 when the plant
operation monitoring system is operated.

Various methods for modeling an object to be
10 photographed may be conceived. In this embodiment, (1) a
three-dimensional model, and (2) two-dimensional models
are combined. The summary of the above-described two
models, and merits and demerits thereof will now be
explained.

15 (1) Three-Dimensional Model

A model in that the shape and the position of
an object to be photographed are defined by a three-
dimensional coordinate system. As a merit, an object in
accordance with an arbitrary camera parameter can be
20 identified. In other words, an object can be operated
while a camera is freely operated. As a demerit, since a
model must be defined in the three-dimensional space, a
model forming process and an object identifying process
become complex, as compared with those for the two-
25 dimensional (2D) model. Very recently, it should be
noted that since there are many cases that CAD (computer
aided design) is utilized in designing a plant, and in
designing/positioning devices employed in the plant, if

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1 these data are applied, the three-dimensional model may
be easily formed.

(2). Two-Dimensional Model

5 A model in that the shape and the position of
an object are defined by a two-dimensional coordinate
system (display plane) with respect to a specific camera
parameter. As a merit, a model can be easily formed. A
model may be defined in such a manner that a pattern is
drawn on a screen. As a demerit, only an operation is
10 carried out with respect to a picture of a camera
parameter in which a model is previously defined. To
increase a free degree of a camera task, a shape and a
position of an object must be defined on a corresponding
plane for each of the camera parameters greater than
15 those of the three-dimensional model. In most operation
monitoring system, there are many cases that several
places which are to be monitored have been previously
determined. In such a case, since several sorts of
camera parameters are previously determined, the demerit
20 of the two-dimensional model does not cause any problem.

A method for identifying an object based on the
3-D (dimensional) model will now be explained with
reference to Figs. 14 to 17. In Fig. 14, there is shown
such an example that the object to be photographed by the
25 camera 60 shown in Fig. 6 is modeled in the 3-D
rectangular coordinate system x, y, z (will be referred
to a "world coordinate system"). In this drawing, the
shape of each object is modeled by a plane, a rectangular

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1 parallelepiped, and a cylinder and the like. Many other
3-D basic forms than a cube and a tetrahedron may be, of
course, employed. Also, not only the basic shapes are
combined with each other, but also models having more
5 precise shapes than those of the basic shapes may be
utilized. Objects 400, 410, 412, 414, 416, 420, 422 and
424 to be operated are modeled on models as planes 800,
810, 812, 814, 816, 820, 822 and 824, respectively.

Referring now to Fig. 15, a relationship
10 between a picture photographed by a camera and a 3-D
model will be explained. A photographing operation by a
camera corresponds to such an operation that an object
arranged within a three-dimensional space is projected
onto a two-dimensional plane (video display region 200).
15 That is to say, the picture displayed in the video
display region 200 corresponds to such a picture that the
object positioned in the 3-D space is projected onto a
two-dimensional plane by the perspective projection.
Assuming now that the 2-D orthogonal coordinate system
20 X_s, Y_s defined on the screen is called as the screen
coordinate system, the photographing operation by the
camera may be formulated as a formula (1) for imaging one
point (x, y, z) in the world coordinate system onto one
point (X_s, Y_s) in the screen coordinate system:

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$$\begin{bmatrix} X_s \\ Y_s \\ 1 \end{bmatrix} = T \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix} = \begin{bmatrix} t_{11} & t_{12} & t_{13} & t_{14} \\ t_{21} & t_{22} & t_{23} & t_{24} \\ t_{31} & t_{32} & t_{33} & t_{34} \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

... (1)

1 A matrix T in the above formula (1) will now be referred to a view transformation matrix. The respective elements in the view transformation matrix may be determined if the camera parameters (position, attitude, direction and view angle of camera) and the size of the video display region 200 are given. The camera parameters are given in the world coordinate system. In Fig. 15, the position of the camera corresponds to a coordinate of a center "Oe" of the lens, the attitude of the camera corresponds to a vector OeYe, and the direction of the camera corresponds to a vector OeZe.

 An identification process of an object corresponds to a process for determining which point in the world coordinate system has been projected onto a point "p" in the screen coordinate system when one point "p" is designated in the screen coordinate system. As shown in Fig. 16, all of points present on an extended straight line for connecting a center Oe of the lens of the camera with the point "p" on the screen coordinate system are projected onto the point "p". A point among the points

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1 on this straight line, which is actually projected onto
the video display region 200 by the camera, corresponds
to a cross point between the straight line and the object
1 positioned nearest the center O_e of the lens. In Fig.
5 16, a cross point P_1 between the object 1 and the
straight line 840 is projected onto one point "p" in the
video display region 200. In other words, assuming now
that the event position is located at the point "p", the
object 1 is identified.

10 The technique for obtaining the view trans-
formation matrix T from the camera parameter and the
technique for displaying the model defined in the world
coordinate system based on the view transformation matrix
 T by the perspective projection onto the screen coor-
15 dinate system, are well known techniques in the graphic
field. The process for projecting a surface of an object
positioned near a camera and for not projecting a surface
onto a screen, which is hidden by another object with
respect to the camera during the perspective projection,
20 is referred to either a hidden-surface elimination, or a
visible-surface determination. A large number of
algorithms have been developed. The techniques are
described more in detail in, for instance, "Computer
Graphics Principles and Practice" written by Foley,
25 vanDam, Feiner, and Hughes issued by Addison Wesley
(1990), and "Principles of Interactive Computer Graphics"
written by Newman, Sproull issued by McGraw-Hill (1973).
In most graphic work station, the graphic functions such

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1 as setting of the view transformation matrix, perspective
projection, and hidden-surface elimination from the
camera parameter, have been previously installed by way
of the hardware and software, and these can be processed
5 at a high speed.

In this embodiment, the process for identifying
the object is performed by utilizing these graphic
functions. In a 3-D model, a surface of an object to be
processed is previously colored, and discrimination can
10 be done which color of the surface belongs to which
object. For instance, in Fig. 14, different colors are
set to the planes 800, 810, 812, 814, 816, 820, 822 and
824. The colors set to the respective objects will now
be referred to ID (identifier) colors. A sequence of
15 identification process with employment of a 3D model with
this ID color is shown in Fig. 17. First, a present
camera parameter is inquired (step 1300), and the view
transformation matrix is set based upon the inquired
camera parameter (step 1310). In the man-machine server
20 20, the present camera condition is continuously managed,
and when an inquire is made of the camera parameter, the
camera parameter is returned in response to the present
camera condition. The present camera condition may be
managed by the camera controlling controller. At a step
25 1320, based upon the view transformation matrix set at
the step 1310, the colored model is drawn into a rear
buffer of the graphic frame buffer 340. In this drawing
operation, both of the perspective projection process and

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1 the hidden-surface elimination process are carried out.
Since the colored model are drawn into the rear buffer,
the drawn result does not appear on the display 10. When
the drawing operation is completed, the pixel values of
5 the rear buffer corresponding to the event position are
read out (step 1330). The pixel values are the ID color
of the object projected onto the event position. The ID
color corresponds to the object in an one-to-one rela-
tionship, and the object may be identified.

10 Referring now to Figs. 19A to 25, a method for
identifying an object based on a 2D (dimensional) model
will be explained. In the 2D model, a shape and a
position of the object after being projected from the
world coordinate system to the screen coordinate system
15 is defined. If the direction or the angle of view of the
camera is changed, the position and the shape of the
object projected onto the screen coordinate system are
varied. Therefore, the 2D model must own the data about
the shape and position of the object with respect to each
20 camera parameter. In this embodiment, the object is
modeled by a rectangular region. That is to say, an
object under a certain camera parameter is represented by
a position and a size of a rectangular region in the
screen coordinate system. The object may be modeled with
25 employment of other patterns (for instance, a polygon and
a free curve).

Figs. 19A, 19B, 20A, 20B, 21A and 21B indicate
relationships between camera parameters and two-

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1 dimensional models. Figs. 19A, 20A and 21A show display
modes of the video display region 200 with respect to the
respective camera parameters. Figs. 19B, 20B and 21B
indicate the two-dimensional models of the object corre-
5 sponding to the respective camera parameters. In Fig.
19A, objects 410, 412, 414, 416, 420, 422 and 424 on a
picture are represented as rectangular regions 710, 712,
714, 716, 720, 722, 724 in the two-dimensional models of
Fig. 19B. A rectangular group of the objects modeled in
10 response to a single camera parameter is called as a
region frame. A region frame 1 corresponding to the
camera parameter 1 is constructed of rectangular regions
710, 712, 714, 716, 720, 722 and 724. Figs. 20A, 20B,
21A, 21B represent examples of region frames corre-
15 sponding to the different camera parameters. In Figs.
20A and 20B, a region frame 2 corresponding to the camera
parameter 2 is composed of rectangular regions 740, 742,
746, 748. These rectangular regions 740, 742, 746 and
748 correspond to the objects 412, 416, 424 and 422,
20 respectively. Similarly, in Figs. 21A and 21B, the
region frame 3 corresponding to the camera parameter 3 is
constructed of a rectangular region 730. The rectangular
region 730 corresponds to the object 400. One object can
correspond to different rectangular regions if the camera
25 parameters thereof are different from each other. For
instance, the object 416 corresponds to the rectangular
region 716 in case of the camera parameter 1, whereas
this object 416 corresponds to the rectangular region 742

1 in case of the camera parameter 2.

In Figs. 23, 24 and 25, there are shown data structures of a two-dimensional model. In Fig. 23, reference numeral 1300 is a camera data table for storing data corresponding to each camera. In the camera data table 1300, both of data about camera parameters operable for an object within a picture, and data about region frames corresponding to the respective camera parameters are stored.

10 In Fig. 24, reference numeral 1320 shows a data structure of a camera parameter. The data of the camera parameter is constructed of a vertical angle corresponding to the camera direction in the vertical direction, a horizontal angle corresponding to the camera direction in the horizontal direction, and an angle of view indicative of a degree of zooming. In this example, it is assumed that the attitude of the camera and the position of the camera and the position of the camera are fixed. When the attitude of the camera and the position of the camera can be remote-controlled, data used to control these items may be added to the camera parameter 1320. The camera parameter 1320 is used to set the camera to a predefined camera parameter. In other words, the man-machine server 20 transfers the camera parameter to the camera controlling controller, thereby remote-controlling the camera. It should be noted that the camera parameter 1320 is not directly needed in performing the process for identifying the object.

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1 Fig. 25 represents a data structure of a region
frame. The region frame data is arranged by the number
of regions for constituting the region frame and data
related to the respective rectangular regions. The
5 region data are constructed of a position (x, y) of a
rectangular region in the screen coordinate system; a
size (w, h) of a rectangular region; an active state,
operation, and additional information of an object. The
active state of the object is such a data for indicating
10 whether or not the object is active, or inactive. When
an object is under the inactive state, this object is not
identified. Only an object under the active state is
identified. A pointer to an event/operation correspond-
ing table 1340 is stored in the operation field. The
15 operation to be executed when the object is designated by
a PD, is stored with forming a pair with the event into
the event/operation corresponding table 1340. It should
be noted that an event is to designate an operation sort
of PD. For instance, an event when the pressure sen-
20 sitive touch panel 12 is strongly depressed is different
from an event when the pressure sensitive touch panel 12
is lightly depressed. Upon generation of an event, an
object located at the position of this event is identi-
fied, and then the operation corresponding to the event
25 matched to the generated event is executed among the
event/operation pairs defined to this object. To the
additional information of the region frame, a pointer to
the additional information 1350 of the object, which

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1 cannot be expressed only as the rectangular region is
stored. There are various types of additional informa-
tion. For instance, there are a text, color, and a title
of an object drawn in an object, and related information
5 (e.g., a manual of an apparatus, maintenance information,
design data). As a result, based upon the text drawn in
the object, the object is searched and the related infor-
mation of the designated object is represented.

10 In Fig. 22, there is shown a sequence to
identify an object by using a two-dimensional model.
First, a region frame corresponding to the present
camera parameter is retrieved from the camera data table
1300 (step 1200). Subsequently, a region containing an
event position is retrieved from the region for consti-
15 tuting the region frame. In other words, data about the
position and size of the respective regions stored in the
region frame data is compared with the event position
(step 1220), and if the region located at the event
position is found out, this number is returned to the
20 host processing system. The host processing system
checks whether or not the found region corresponds to the
active state. If it becomes the active state, then the
operation defined in accordance with the event is
performed. A step 1220 is repeated until either the
25 region containing the event position is founded, or all
regions within the region frame have been checked (step
1210).

A two-dimensional model is defined by utilizing

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1 a two-dimensional model definition tool. The two-
dimensional model definition tool is constructed of the
following functions.

(1). Camera Selecting Function

5 This function implies that an arbitrary camera
arranged in a plant is selected and then a picture
derived from this selected camera is displayed on a
screen. There are the following camera selecting
methods:

10 * A camera for imaging an object is designated by
designating this object on an arranging diagram of a
plant displayed on a screen.

* A place where a camera is arranged is desig-
nated on an arranging diagram of a plant displayed on a
15 screen.

* Identifiers for the number and a name of a
camera are designated.

(2). Camera Work Setting Function

20 This function implies that the above-described
camera selected by the camera selecting function is
remote-controlled, and a direction and an angle of view
of the camera are set.

(3). Pattern Drawing Function

25 This function means that a pattern is drawn on
a picture displayed on a screen. A pattern drawing is
performed by combining basic pattern elements such as a
rectangle, a circle, a folded line, and a free curve. An
approximate shape of an object is drawn by underlying a

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1 picture of an object by way of this function.

(4). Event/Operation Pair Definition Function

2 This function implies that at least one pattern
3 drawn by the pattern drawing function is designated, and
4 a pair of event/operation with respect to this design-
5 nation is defined. An event is defined by either
6 selecting a menu, or inputting a title of the event as a
7 text. An operation is described by selecting a
8 predefined operation from a menu, or by using an entry
9 language. As such an entry language, for instance, the
10 description language UIDL is employed which is described
11 in the transaction of Information Processing Society of
12 Japan, volume 30, No. 9, pages 1200-1210, User Interface
13 Construction Supporting System Including Meta User
14 Interface.
15

16 This description language UIDL (User Interface
17 Definition Language) will now be summarized as an
18 example.

19 In UIDL, the event/operation pair is defined by
20 the following format.

event title (device) (operation)

21 An "event title" designates a sort of operation
22 performed to a region on a screen defined by a pattern.
23 The event title in case that the pressure sensitive touch
24 panel 12 is employed, and a content of an operation
25 corresponding to this event title are represented as
follows. Another event title is designated when other
devices such as a mouse are employed as a pointing

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1 device.

soft-touch: this event is produced when the touch panel 12 is lightly touched by a finger.

5 hard-touch: this event is produced when the touch panel 12 is a strongly touched by a finger.

soft-off: this event is produced when a finger is detached from the touch panel 12 after this panel is lightly touched by the finger.

10 hard-off: this event is produced when a finger is detached from the touch panel 12 after this panel is strongly touched by the finger.

soft-drag: this event is generated when a finger is moved while the touch panel 12 is lightly touched by the finger.

15 hard-drag: this event is generated when a finger is moved while the touch panel 12 is strongly touched by the finger.

20 A "device" is to designate from which apparatus, the event has been produced in case that there are plural apparatuses for generating the same events. For example, when there are two buttons on a mouse in right and left sides, a designation is made from which button, this event is generated. In this embodiment, since the apparatus for producing the above-described event corresponds to only the pressure sensitive touch panel 12, no
25 designation is made of the event.

An "operation" is to define a process which is executed when an operation corresponding to the "event

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1 title" is performed to a region defined by a pattern.
The "operation" is defined by combining prepared basic
operations with each other by employing syntax (branch,
jump, repeat, procedure definition, procedure calling
5 etc.) similar to the normal programming language (for
instance, C-language etc.). An example of a basic
operation will now be explained.

activate ():

Activating an object.

10 deactivate ():

Deactivating an object.

appear ():

Displaying a pattern for defining a region of
an object.

15 disappear ():

Erasing a display of a pattern for defining a
region of an object.

SwitchCamera (camera, region):

20 Displaying a picture of a camera designated by
an argument camera in a region on the display screen 100
designated by an argument region.

setCameraParameter (camera, parameter):

25 Setting a camera parameter to a camera. The
argument camera designates a camera to be set. An
argument parameter designates a value of a camera
parameter to be set.

getCameraParameter (camera, parameter):

Returning a value of a present camera para-

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1 meter. A camera parameter of a camera designated by an argument camera is set to an argument parameter.

call external-procedure-name (argument-list):

5 Calling a procedure formed by other programming language (e.g., C-language). Both of the calling procedure and the arguments thereof are designated by "external procedure name", and "argument-list", respectively.

send object-name operation-name (argument-list):

10 Either basic operation of another object, or a procedure is called out. Either the basic operation to be called out, or the procedure and arguments thereof are designated by "operation name" and "argument-list", respectively.

15 In the above-described 2-D model definition tool, a two-dimensional model is produced by way of the following steps.

Step 1: Designation of Camera and Camera task

20 A camera is selected with employment of the above-described camera selection function, and then a picture obtained by the selected camera is displayed on a screen. Next, a camera task is set by utilizing the above-described (2) camera task setting function, to obtain a picture of a desirable place.

25 Step 2: Definition of Outline of Object:

An outline of an object defined as an object among objects on a picture displayed by the step 1 is drawn by utilizing the above-described (2) pattern

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1 drawing function.

Step 3: Definition of Pair of Event and Operation:

At least one of patterns drawn by the procedure
2 is selected by employing the above-described (4)
5 event/operation pair definition function, to define a
pair of event and operation.

Step 4: Storage of Definition Content:

A content of definition is stored, if required.
The definition contents are stored in the data structures
10 as shown in Figs. 23, 24 and 25. When a 2-dimensional
model is wanted to be formed with respect to another
camera and another camera task, the step 1 to the step 4
are repeated.

The 2-D model definition tool may be installed
15 on the man-machine server 20, may be displayed on the
display 10, or may be installed on a completely different
work station and personal computer, so that the defined
2-D model may be transferred to the man-machine server
20.

20 An example of the above-described 2-D model
definition tool is represented in Fig. 26. In Fig. 26,
reference numeral 1500 indicates the two-dimensional
model definition tool; reference numeral 1501 shows a
text input field for inputting a title of a region frame;
25 reference numeral 1502 is a menu for producing/editing a
region frame by combining basic patterns (straight line,
rectangle, ellipse, arc, folded line, polygon), and for
defining an operation thereto. Reference numeral 1503

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1 shows a management menu for storing and changing the
produced region frame; reference numeral 1504 is a menu
for selecting a camera; reference numerals 1505 to 1509
denote menus for remote-controlling the camera selected
5 by the menu 1504 so as to pan/zoom the camera. Reference
numeral 1510 shows a region for displaying a picture of a
camera selected by the menu 1504 and also a region in
which a region frame is superimposed on the picture;
reference numeral 1511 is a rectangle drawn in the region
10 1510 in order to model the object 414; and reference
numeral 1512 denotes a pointer move in conjunction with
an input of a positional coordinate value from a pointing
device such as a mouse and a touch panel. In the follow-
ing example, a mouse equipped with two buttons at right
15 and left sides is used as the pointing device. Moving
the mouse while depressing the buttons of the mouse is
referred to "drag". Depressing a button of the mouse and
releasing it while the mouse is not moved is referred to
"click". Continuously performing the "click" operation
20 twice is referred to "double click".

Functions of the respective items of the menu
1502 are as follows:

Straight line: A function to draw a straight line.
After this item is selected, when the mouse is dragged
25 within the region 1510, a straight line is drawn which
connects the position of the pointer 1512 when the drag
is started, and the position of the pointer 1512 when the
drag is ended.

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1 Rectangle: A function to draw a rectangle. After
this item is selected, if the mouse is dragged within the
region 1510, a rectangle is drawn in such that both of
the position of the pointer 1512 when the drag is
5 started, and the position of the pointer 1512 when the
drag is ended constitute diagonal vertexes.

Ellipse: A function to draw an ellipse. After this
item is selected, when the mouse is dragged within the
region 1510, an ellipse is drawn which is inscribed with
10 a rectangle wherein both of the position of the pointer
1512 when the drag is started and the position of the
pointer 1512 when the drag is ended constitute a diagonal
line.

Folded line: A function to draw a folded line.
15 After this item is selected, when the movement of the
pointer 1512 and the click of the mouse (button) are
repeated within the region 1510, and finally the mouse is
clicked twice at the same position, a folded line is
drawn which is made by sequentially connecting the
20 positions of the pointer 1512 when the mouse is clicked
by straight lines.

Polygon: A function to draw a polygon. After this
item is selected, when the movement of the pointer 1512
and the click of the mouse are repeated within the
25 editing region 1510, and finally the mouse is clicked
twice at the same time, a polygon is drawn which is made
by sequentially connecting the positions of the pointer
1512 when the mouse is clicked by straight lines, and by

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1 connecting the final point with the start point.

Deletion: A pattern designated by the pointer 1512 is deleted, and at the same time, this pattern is stored into a buffer (will be referred to a "paste buffer").

5 Copy: The pattern designated by the pointer 1512 is copied into the paste buffer.

Paste: A content of the paste buffer is drawn at the position of the pointer 1512 when the latest mouse is clicked.

10 Group: A plurality of patterns designated by the pointer 1512 are grouped. A plurality of grouped patterns will be handled as a single pattern. To model a single object by utilizing a plurality of pattern, these patterns are grouped. When this item is selected in case
15 that only one grouped pattern is designated, the designated group is released and returned to a plurality of original drawings.

Operation: An operation definition sheet for defining an event/operation pair to the pattern designated by the pointer 1512 is called out.
20

Functions of the respective items of the menu 1503 are given as follows:

New: A region frame is newly defined.

Open: A name of a region frame designated at the
25 input field 1501 is called out and then displayed at the region 1510. At the same time, the camera parameter is set which corresponds to the camera related to the called region frame, and a picture of this camera is displayed

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1 at the region 1510.

Store: The defined region frame is stored in the name designated by the input field 1501 with a pair of camera/camera parameter.

5 End: The model definition tool is ended.

Functions of menus 1505 to 1509 are as follows:

Menu 1505: A camera is panned in upper/lower directions and right/left directions.

Menu 1506: A camera is zoomed in.

10 Menu 1507: A camera is zoomed out.

Menu 1508: A camera is set to one preceding camera parameter.

Menu 1509: A camera is set to a value of a camera parameter when being finally stored (select the item
15 "store" of the menu 1503).

When the menu 1504 is selected, a picture of the selected camera is displayed in the region 1510. A camera is remote-controlled by utilizing the menus 1505 to 1509, and set to a desirable camera parameter. In the
20 model definition tool 1500, the camera is selected by the menu 1504. Alternatively, an icon may be displayed in the plant systematic diagram to clearly indicates an arrangement of a camera, and the camera may be selected by way of a method for selecting the icon.

25 In accordance with the model definition tool 1500, the object is modeled by combining the basic drawings (straight line, rectangle, ellipse, arc, folded line, polygon). That is to say, an object projected onto

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1 a screen coordinate system by way of a certain camera
parameter, is expressed by a position and a size of a
single basic pattern, or plural basic patterns. A model
of an object is defined in such a manner that a picture
5 displayed in the region 1510 is underlaid and an outline
of an object being displayed therein is drawn. The
outline of the object is drawn by way of such a manner
similar to the drawing method with employment of the
normal pattern drawing tool. When a desirable basic
10 pattern is selected by the menu 1502, and a size and a
position of the selected basic pattern are designated by
using the pointer 1512 on the region 151, the basic
pattern is drawn on the region 1510. In Fig. 26, the
object 414 is modeled by the rectangle 1511. A single,
15 or plural drawings in which a certain object has been
modeled, will now be referred to a model object.

When the outline of the object is drawn, an
operation is defined to the subsequently drawn pattern,
namely the model object. The operation is defined by
20 employing the operation definition sheet. When the item
"definition" of the menu 1502 is selected, an operation
definition sheet 1500 is opened as shown in Fig. 27. In
Fig. 27, reference numeral 1602 denotes a menu to manage
the sheet 1600; reference numeral 1603 indicates a field
25 to input an object name; reference numeral 1604 shows a
menu to select a sort of events; reference numeral 1605
denotes a menu to select a basic operation which has been
previously defined to an object; and reference numeral

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- 1 1606 denotes a region in which an event/operation pair is described by using the above-described description language UIDL.

When the event/operation pair is entered, the
5 sort of events and the basic operation of the object can be selected from the menus 1604 and 1605. Upon selection of the menus 1604 and 1605, either the selected even name, or the selected basic operation name is inputted into the input position of the region 1606. As a conse-
10 quence, the task for inputting the event name or the basic operation name from the keyboard can be omitted, so that the taskload of the operation entry can be reduced.

Functions of the respective items of the menu 1602 are given as follows:

- 15 Store: A defined operation/definition pair is stored as an event operation/corresponding table of region frame data.

End: An operation definition sheet is ended and a control is returned to the model definition tool 1500.

- 20 Fig. 27 represents such a situation that an operation is defined to a pattern 1511 in which the object 414 is modeled. In an input field 1603 "PowerOnButton" is inputted as the object name of the pattern 1511. Then, in a region 1606, an even/operation
25 pair of "if an object is hardly touched, then a procedure of "RemotePowerOn 0" is called" has been entered.

After the model definition is completed, an item "store" of the menu 1503 is selected to store the

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1 content of the definition in the data structures as shown
in Figs. 23 to 25. When the model definition tool 1500
is operated on the man-machine server 20, the definition
content is stored into the main memory 310 and the disk
5 320.

Since a model of an object is owned, it can be
recognized where and how an object is represented within
a picture. As a result, the information related to the
object may be graphically displayed based upon the posi-
10 tion and the shape of the object within the picture, and
the picture of the object can be retrieved. Examples are
given as follows.

* A name of an object, and function, operation
manual, maintenance method and the like of the object are
15 synthesized on, or near the object to be displayed.

In Fig. 28, there is shown an example that an
explanation related to an object is displayed adjacent to
the object. In this figure, reference numerals 2201 and
2202 denote graphic indicative of the device of the
20 objects 518 and 524, respectively.

* An object formed by graphics is synthesized
with an actually imaged picture to be displayed in such a
manner that this object is actually photographed by a
camera, as it were.

25 * Searching additional information of an object
based on a key word inputted, and setting a camera and a
camera parameter in order to image the relevant object.

* An internal structure of an object which cannot

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1 be photographed by a camera, is synthesized with an
object shown in a picture to be displayed. For instance,
for example, a condition of a water flow in a pipe is
simulated, based on data obtained from another sensor,
5 and then the simulation result is synthesized with the
pipe viewed in the actual image for display purpose.
Similarly, graphics for indicating a condition of flames
within a boiler (for example, a temperature distribution
diagram produced from information obtained from a sensor)
10 is superimposed on the boiler displayed in the picture
for display purpose.

* An object to be attentioned at this time is
clearly indicated by graphics. For example, when an
extraordinary matter is sensed by a sensor, graphics is
15 synthesized with an object in a picture for display
purpose. Graphics are synthesized with an object in a
picture related to data represented in a trend graph, so
that a relationship between the data and the object in
the picture can be immediately recognized.

20 Although the pictures photographed by the
normal camera are utilized in the above-described
embodiment, the present invention may be, of course,
applied to either an image photographed by a specific
camera (infrared camera, fish-eye lens mounted camera,
25 thermography), or an image which has been image-
processed.

As an effect of the present embodiment, at
least one of the following items (1) to (6) can be

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1 achieved.

(1). In a remote operation monitoring system, an operator can intuitively grasp an object to be operated and an operation result, resulting in less error

5 operation.

(2). A desirable monitoring picture can be simply observed without bothering an operator with camera selection, or camera remote control.

(3). An operation can be executed on a monitoring
10 picture. As a consequence, there is no necessity to separate a monitoring monitor from an operation panel. A remote operation monitoring system can be made compact and therefore space saving can be achieved.

(4). Graphics are combined with a camera picture and
15 the combined picture is displayed, so that merits of these graphics and camera picture can be achieved and demerits of each items can be compensated with each other. In other words, an important portion can be emphasized while the feeling of attendance in a field is
20 coveyed.

(5). A representation by which different sorts of information can be mutually referred at once. For instance, by only designating a portion being monitored on a camera picture, a trend graph indicative of a sensor
25 value related to this designated portion can be displayed. Thus, conditions of a field can be comprehensively judged.

(6). A man-machine interface by which an operation

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1 can be directly given to a picture, can be directly given
to a picture, can be simply designed and developed.

It should be noted that although a plurality of
camera video have been used in this embodiment, pictures
5 derived from a plurality of disk reproducing apparatuses
(e.g., optical disk) may be employed.

Referring now to Figs. 29 to 60, a plant
control monitoring system according to another embodiment
(second embodiment) of the present invention will be
-10 described.

In the below-mentioned embodiment, relating
either video or sound with data (control data) used to
control means the synchronous reproduction of either
video or sound with control data, the mutual reference of
15 either video or sound and control data, and synthesizing
either video or sound with control data.

Fig. 29 shows an arrangement of the plant
control monitoring system according to the present
embodiment. An apparatus to be monitored in a field of a
20 factory (will be simply referred to a "controlled
apparatus") 2101 transfers process data indicating
operation conditions via a cable 2135 to a controlling
computer 2102 functioning as a first input means at each
time instant. In the controlling computer 2102, the
25 process data is analyzed, and control signals are sent
via a cable 2136 to the controlled apparatus 2101.
Also, the process data is flown via a cable 2137 into a
LAN 2120, and operator commands which are flown via a

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1 cable 2138 from the LAN 2120, are received and then
processed in the controlling computer 2102. As described
above, a major function of the controlling computer 2102
is to acquire the process data, to output the process
5 data to the LAN, to input the operator commands from the
LAN, and to output the process control signals to the
controlling apparatus 2101.

The LAN 2120 is of a cable "Ethernet", through
which the signals such as the operator commands and the
10 process data are flown. The LAN 2120 is connected to the
respective devices by way of an output cable 2137 from
the controlling computer 2102, an input cable 2138 to the
controlling computer 2102, an output cable 2143 from the
database 2104, an input cable 2144 into the database
15 2104, an output cable 2140 from the work station 2103,
and an input cable 2139 into the work station 2103.

The database 2104 corresponding to first and
third storage units and a first reproducing unit, fetches
the process data and the like flown into the LAN 2120 via
20 the cable 2144, and records the process data and the like
together with a time instant "t" outputted from a clock
internally provided therein. When a data read command is
inputted via the cable 2144, the data designated by this
data read command is transferred via the cable 2143 to
25 the LAN 2120.

A plurality of ITV cameras 2110 are equipped
with camera control devices capable of remote-controlling
the ITV cameras in control modes of pan, tilt, and zoom

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1 upon receipt of control signals, and also microphones
movable in conjunction with the cameras. The cameras
2110 send video images and sound of the controlled
apparatus 2101 via the cables 2130 and 2131 to the
5 switcher 2109. The switcher 2109 transfers the camera
control signal inputted from the work station 2103 via
the cable 2132 to the cameras 2110. The ITV cameras 2110
correspond to a second input unit.

As the video/audio recording unit 2108 corre-
10 sponding to the second storage unit and the second
reproducing unit, a random accessible unit such as an
optical disk is utilized. Although a video tape may be
employed as this random accessible unit, since the data
search of a video tape is carried out sequentially, its
15 data search and display are time-consuming. All of the
video images and sounds derived from the ITV cameras 2110
are passed through the switcher 2109 and inputted from
the cable 2133. When the work station 2103 corresponding
to the control unit inputs the read command via the
20 switcher 2109 by way of the cable 2145, the designated
video/audio information is outputted via the cable 2134
to the switcher 2109.

The switcher 2109 is such a switch for select-
ing the video and sound information when a plurality of
25 inputted videos and sounds are sent via the cable 2141 to
the work station 2103, and also corresponds to a switch
for selecting a signal destination when a camera control
signal and a recorded video calling signal which are

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1 outputted from the work station 2103 via the cable 2142,
are sent to the cameras 2110 and the video/audio
recording unit 2108.

5 The work station 2103 is connected to a display
2111 and a speaker 2112, which correspond to the first
and third output units as output units to the operator,
and also connected to input devices such as a keyboard
2106, a mouse 2105, and a touchpanel 2107 as an input
unit from the operator (a measurement data output
10 designating unit, an unit for selecting an object to be
selected, and an unit for designating a search value of
measurement data). Also, the LAN 2120 is connected by
the cables 2139 and 2140, and the switcher 2109 is
connected by the cables 2141 and 2142. The work station
15 2103 processes the process data inputted from the cable
2139 to form a display screen, and represents the process
data together with the video data inputted from the cable
2141 on the display 2111. On the other hand, the sound
data inputted from the cable 2141 is outputted from the
20 speaker 2112. Both of the speaker 2112 and the display
2111 corresponds to the second output unit. The key
input from the keyboard 2106 by the operator and also the
inputs from the input devices such as the mouse 2105 and
the touch panel 2107 are processed in the work station
25 2103, and also are outputted as the control code of the
controlled apparatus 2101 by the cable 2140, and further
are outputted as the changing command to the video/audio
changing switcher 2109, as the control code of the camera

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- 1 2110, and as the calling code to the video/audio
recording unit 2108.

The operator monitors the situations of the
system indicated by the video, characters and graphics on
5 the display 2111, and executes necessary operation and
command by employing the mouse 2105, keyboard 2106 and
touch panel 2107. For the sake of explanation, the touch
panel 2107 is utilized as the input device from the
operator. Other devices may be, of course, employed as
10 this input device.

Next, an internal structure of the work station
2103 is shown in Fig. 30. Reference numeral 2201 indi-
cates a CPU (central processing unit); reference numeral
2202 is a main memory; reference numeral 2203 denotes an
15 I/O (input/output); reference numeral 2204 shows a
graphic screen frame buffer for displaying process data
on the display 2111; reference numeral 2205 denotes a
digitizer for converting an inputted video signal into a
digital signal; reference numeral 2206 shows a video
20 buffer frame; and reference numeral 2207 is a blend
circuit for blending a graphic screen with a video image.

In Fig. 31, there is represented an arrangement
of the video/audio recording unit 2108. This video/audio
recording unit 2108 is constructed of a CPU 2301 for
25 fetching various instructions derived from the task
station 2103 to process these instructions, and also for
issuing recording/reproducing commands; a main memory
2302 used to buffer the video; an AD/DA (analog-to-

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1 digital/digital-to-analog) converter 2303 for digitizing
a signal from the ITV camera 2110, and for converting a
digital signal into an analog signal to be transferred to
the work station; and furthermore a video/audio record-
5 ing/reading unit 2304.

Fig. 32 represents a display screen in the
process control monitoring system. The display screen is
arranged by a process overall arrangement diagram 2401, a
motion picture display region 2402 for mainly displaying
10 video images from the ITV cameras, a trend graph 2403 for
displaying the process data from the controlled apparatus
2101; a clock 2406; a task region 2404 for displaying
switch, help information and the like; a process data
displaying meter 2405; and also a menu region 2407.
15 Within the menu region 2407, there are represented a
camera changing button 2408; a button 2409 for designat-
ing an object to be selected within a video image and
process data; a mode button 2410 for selecting a monitor
mode and a reproduction mode, a standard reproduction and
20 a slow reproduction; a selecting button 2411 for select-
ing a simple editor calling operation, and a graph to be
displayed; Assuming now that the process data from the
controlled apparatus 2101 is displayed in this menu
region 2407, other data list and scalar may be displayed.
25 Also, a plurality of data display means which has been
explained above may be provided on the display.

Fig. 33 shows more in detail the trend graph
2403 for showing the process data. The trend graph 2403

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1 is constructed of a data display unit 2501, a data item
display unit 2502, a time cursor 2503, a temporal axis
2504, a data value cursor 2505, and temporal axis moving
buttons 2506 and 2507.

5 The process data is displayed as a graph on the
data display unit 2501, and also a title thereof is
displayed on the data item display unit 2502. A rela-
tionship between data and a title thereof is achieved by
a width of a line, and color or sort of lines.

10 The time cursor 2503 represents by employing
the temporal axis 2504, the recorded time instant, or
generations of all data (for instance, a data value
indicated by the meter 2405, a picture 2402, a time
instant of the clock 2406, a point on the tie cursor 2503
15 of the trend graph 2403) being displayed on the present
display. In other words, the time cursor 2503 of the
trend graph 2403 corresponds to a time display unit for
indicating the time instant recorded by the presently
displayed data.

20 The temporal axis 2504 displays a value of a
present time instant if a time instant when data to be
displayed is produced is not present within the temporal
axis 2504 under display, by moving the value of the time
instant under display along a right direction (namely, a
25 time returning direction, which will be referred to a
"reverse direction"), or a left direction (namely, a time
leading direction, which will be referred to a "positive
direction"). The temporal axis 2504 may be expanded or

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- 1 reduced, and a section thereof may be expanded or
reduced. As a result, a section of the temporal axis
2504 which is desired to be observed in detail is
expanded, whereas another section thereof which is not
5 desired to be observed in detail, is reduced.

- The temporal axis moving button 2507 is to move
a value of a time instant displayed on the temporal axis
2504 along the right direction, so that a time instant
preceding the present time under display is represented.
10 On the other hand, the button 2508 is to move the value
of the time instant along the left direction so as to
represent a time instant succeeding the present time
under display.

- The data value cursor 2505 is to search the
15 process data. After the process data to be searched has
been selected, when the data value cursor is brought to a
search value, both of the temporal axis 2504 and the time
instant cursor 2503 are moved, and then the time instant
cursor 2503 approaches a time instant when the selected
20 data indicates the search value.

- In the following example, a trend graph is
employed as the data display unit for displaying the
process data on the display. Any other data display
units than the trend graph may be employed.

- 25 There are the following functions in the
process monitoring system according to the present
embodiment:

- (1). The operation for reproducing the recorded

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- 1 video images can not only reproduce the video images and
the sound, but also can retrieve the process data at the
time instant when this video image was taken and can
display this process data.
- 5 (2). With employment of the time display unit such
as the time instant cursor 2503 of the trend graph, the
time instant is designated, whereby both of the video
image and the sound at the time instant when this data
was recorded, and also the process data at this time
10 instant is retrieved to be displayed.
- (3). The process data is searched by designating
this process data and the search value thereof. This
data is called out and displayed, and furthermore both of
the video image at the time instant when this data was
15 recorded and other process data at this time instant are
called out to be represented.
- (4). When the recorded video image is reproduced,
the display frequency of the process data with respect to
the time is varied by this reproducing speed.
- 20 (5). The display frequency related to the time
instant of the process data is previously designated, so
that the reproducing speeds for the video and the sound
in conformity to this display frequency are determined
when the video is reproduced, and then the video and the
25 sound are reproduced and displayed.
- (6). The operation information from the operator is
recorded, and also the operation by the operator is also
reproduced when the video image is reproduced.

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1 (7). The operation information from the operator is
recorded and the operation data of the operator is desig-
nated, whereby this operation is searched, and the video
and the process data when the operation was performed are
5 called out and displayed.

(8). In a video image, objects to be selected by the
operator using the touch panel have been defined. When
the video image is reproduced, the operator selects this
object to display the related process data.

10 (9). In a video image, objects to be selected by the
operator using the touch panel have been defined. When
the operator selects one of the objects during the
reproduction of the video image, the related process data
is displayed in the emphasized mode.

15 (10). In a video image, objects to be selected by the
operator using the touch panel have been defined. When
the operator selects one of the objects when the picture
is reproduced, whereby the selection menu concerning the
related process data is displayed. When one item is
20 selected from this menu, the process data of the selected
item is displayed.

(11). In a video image, objects to be selected by the
operator using the touch panel have been defined. When
the operator selects one of the objects when the video
25 image is reproduced, whereby the related process data is
displayed on the selected object within the video image.

(12). In a video image, objects to be selected by the
operator using the touch panel have been defined. When

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1 the operator selects one of the objects when the video
image is reproduced, whereby the related process data is
displayed by computer graphics and superimposed on the
picture.

5 (13). In a video image, objects to be selected by the
operator using the touch panel have been defined. When
the operator selects one of the objects when the video
image is reproduced, whereby another object to be
selected within the related video image is displayed in
10 the emphasized mode.

(14). In a video image, objects to be selected by the
operator using the touch panel have been defined. When
the operator selects one of the objects when the video
image is reproduced, whereby the additional information
15 of this selected object is displayed.

(15). In a video image, objects to be selected have
been defined in a video image. When the operator selects
one of the process data when the picture is reproduced,
whereby the present picture is changed into the video
20 image related to the selected process data and also
objects to be selected within the video image is
displayed.

(16). In a video image, objects to be selected have
been defined in a video image. When the operator selects
25 one of process data when the picture is reproduced,
whereby the present video image is changed into the video
image related to the selected process data and also the
selected object within the picture is displayed, and

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1 further the data value thereof is superimposed on the
selected object for display purpose.

(17). Object to be selected have been defined in a
video image, whereby the present video image is changed
5 into the video image related to the selected process data
and also the selected object within the video image is
displayed, and further the data value thereof is super-
imposed on the video image with using the computer
graphics for display purpose.

10 The above-described functions will now be
explained more in detail with respect to the productions
of the recorded process data, picture data and audio
data.

Referring now to Figs. 29 to 39, the function 1
15 will be described. A recorded information standard
reproducing mode is set by selecting the mode changing
button 2410 with employment of the touch panel. While an
optical disk is reproduced, a recording operation is
carried out for another optical disk different from the
20 former optical disk. As shown in Fig. 32, the video
controller 2603 is displayed in the task region 2404.
As shown in Fig. 35A, the video controller includes: a
reproducing button 2705 with a double reproducing speed
in a forward direction; a reproducing button 2704 with a
25 standard reproducing speed in a forward direction; a
reproducing button 2701 with a double reproducing speed
in a reverse direction; a reproducing button 2702 with a
standard reproducing speed in a reverse direction; and a

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1 picture stop button 2703. When a slow mode reproduction
is selected by a mode selection button 2410, as shown in
Fig. 35B, a reproducing button 2706 with a 1/2 double
reproducing speed in a reverse direction; and a reproduc-
5 ing button 2707 with a 1/2 double reproducing speed in a
forward direction are displayed instead of the reproduc-
ing button with a double reproducing speed in a reverse
direction and the reproducing button with a double
reproducing speed in a forward direction. It should be
10 noted that a reproducing operation of picture and sound
information at a standard speed implies that such a
reproduction is carried out at the same speed as in a
recording operation, and a forward direction corresponds
to a direction of time elapse. Accordingly, for
15 instance, a reproduction with a double reproducing speed
in a reverse direction implies that a reproducing
operation is carried out at a double recording speed in a
direction reverse to the time elapse direction. In this
example, although the reproducing mode is divided into
20 the standard mode and the slow mode when the recorded
information is reproduced, the present invention is not
limited to these two modes.

When the reproducing button 2704 with the
standard reproducing speed in the forward direction is
25 depressed on the touch panel, both of the video data and
the audio (sound) data are reproduced at the standard
speed in the forward direction, and the reproduced video
data is displayed on the video display unit 2402. At

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1 this time, the time cursor 2503 within the trend graph is
moved in conformity with this picture, and the process
data at the time instant when the displayed picture was
recorded, appears on the time cursor 2503. When the time
5 cursor 2503 comes to a certain place, the process data is
called from the database 2104, and then the time instant
value being displayed on the time axis 2504 is moved to
the left direction (right direction), so that process
data at a new time instant which is not present at the
10 present time axis 2504 is displayed. When other pictures
are imaged, data about values at these picture imaging
operations are sequentially displayed on other process
data display units such as the meter 2405. As previously
explained, not only the video and audio information is
15 reproduced, but also the process data acquired at the
time instant when this video information is obtained are
called from the database so as to be displayed by operat-
ing the above-described picture reproducing operation.

As a consequence, the process data acquired at
20 the time instant when the picture is photographed can be
observed while watching this picture. Also, since other
reproducing buttons are used, the fast forward, reverse
reproduction, slow reproduction and the like may be
performed with respect to the video information, which is
25 useful to discover/analyze, extraordinary matters, by
which an operation condition is diagnosed and also a
control instruction for the operation condition is
issued.

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1 a block of the process data is inputted from the work
station 2103 to the database 2104, data having a
structure as shown in data 2810 of Fig. 36C is trans-
ferred to 2103. This data 2810 is constructed of a
5 header 2811 indicating a start of the process data, a
sort of data 2812, a data number 2813, data 2814 to 2816
corresponding to the process data, time instant data 2817
of the data 2814 and time instant data 2819 of the data
2816. Depending upon the sorts of block calling instruc-
10 tion, data lengths and intervals of the time instant data
may be, of course varied.

Subsequently, a recording operation of video
and sound data will now be explained. First, as
indicated in Fig. 36D, 2830 shows the structures for
15 video/audio data to be recorded. Generally speaking,
since video data derived from a plurality of cameras are
recorded, the respective video/audio data owns an index
2831 (disk No.) and a title of data 2832 (camera No., or
boiler No.). In this drawing, reference numeral 2834
20 indicates a time instant when a sound is recorded;
reference numeral 2833 represents an audio (sound)
information; reference numeral 2835 shows a time instant
when video is recorded, and reference numeral 2836
denotes video information. It should be noted that the
25 video information and the audio information are
separately recorded as shown in this figure, but
alternatively, both of the video information and the
audio information may be recorded in combination

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1 therewith. In case of such a combination recording
operation, the time instant information is commonly
utilized.

Referring now to Fig. 37, a description will be made of a method for recording the above-described video and audio data, and also a method for reproducing the video and audio data. In this embodiment, as to the video recording operation, a 3-staged sequence (steps) as indicated by 2901 to 2903 is performed in the CPU 2201 of the work station 2103. After this sequence has been executed, the recording operation is commenced at a step 2904. In the video recording operation, when the system is initiated, and when the reproduction mode is accomplished and then the operation mode is returned to the recording mode, all of video screens are first recorded. Subsequently, as shown in a step 2905, the video information is recorded at a step 2906 only when the recording condition is satisfied. With respect to the audio information, since a capacity required for recording the audio information is relatively smaller than a capacity required for recording the video information, the audio information is recorded at any time. Both of the recording/reproducing operations only for the video information will now be described.

25 At a step 2901 for determining a video object
to be recorded, a determination is made which object is
to be recorded. As a concrete method, any one of the
following method is employed.

1 (1). All of camera picture screens are set to be
recorded. As an implementation method, all of the video
signals derived from the cameras are to be recorded.

5 (2). Regions containing a portion outputting process
data, a moving portion, and a changing portion are
previously designated. Only these regions are to be
recorded. Data 2840 shown in Fig. 36E correspond to a
data structure of the video data 2836 in this case. An
element of the data 2840 is arranged by image data 2846
10 to be recorded, and positional information thereof,
namely coordinate values 2841 and 2842 of this image
data, sizes of image data (spatial dimension of a screen)
2843, 2844, and a time instant (or index) 2845 when the
latest all screen data have been recorded. As an
15 implementation method, when an ITV camera is zoomed,
titled, and panned, all screens are recorded. After such
a camera operation, when the camera operation is stopped,
the video data 2836 is sent to the work station 2103, so
that an image analysis is carried out and then a region
20 containing an object to be recorded is defined. For the
sake of simplicity, this region may be a rectangle, for
example. Once this region is determined, positional
information of this region such as a coordinate value and
a size is sent to the video/audio recording unit 2108,
25 and subsequently, only this region sent from the camera
is picked up and recorded by the CPU 2301. During the
reproducing operation, the video data at the time instant
2845 is called and then blended with the recorded data

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1 2846 by the CPU 2301, so that all screens are produced.

At a step 2902 for determining a video recording condition, a condition for recording a picture is determined. As a concrete condition, any one of the following conditions is employed.

(1). A recording operation is performed at a predetermined time interval. This is performed that the CPU 2201 and 2301 within either the work station 2103, or the video/audio recording unit 2108 include clocks. In the former case, an instruction for recording video data for each constant time is sent to the video/audio recording unit 2108. In the latter case, only an instruction to commence a recording operation is transferred to the video/audio recording unit 2108. Thereafter the CPU 2301 manages the recording time.

(2). When the difference between the present video image and the last recorded video image from each camera becomes higher than a certain threshold value, the present picture is recorded. This is performed that the difference value between the video information of the screen which has been recorded in the main memory 2302 within the video/audio recording unit 2108 and the video information at the present time, is calculated in the CPU 2301, and the recording instruction is sent to the video/audio reading unit 2304 in response to this value.

(3). When each of the process data exceeds a constant value specific to this process data, video images related to the data are recorded. This is done

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1 that the process data entered into the work station 2103
is processed in the CPU 2201, and an instruction is
issued to the video/audio recording unit 2108 in such a
manner that a video image of a camera taking such an
5 image related to extraordinary data is recorded.

(4). When the difference between the present value
and the preceding value of each process data exceeds a
constant value specific to this process data, video
images related to this process data are recorded. This
10 implementation method is similar to the item (3).

(5). When a weighted average of the respective pro-
cess data exceeds a constant value, video images related
to this data is recorded. In other words, assuming now
that a weight is $w_i (w_i \geq 0)$ and the respective process data
15 is d_i , the following value exceeds this constant value:

$$e = \sum w_i * d_i$$

An implementation method is the same as the above item
(3).

(6). A recording operation is carried out at a
predetermined time interval, and another recording
20 operation is performed at a shorter time interval when
any one of the above-described conditions is satisfied,
and then if the condition is not satisfied, this shorter
time interval is returned to the original time interval.

The step 2903 for determining a video recording
25 method define a recording method. As a concrete example,

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1 there is any one of the following concrete conditions:

(1). Video information derived from an ITV camera is directly recorded.

(2). The difference between a present screen and a
5 previous screen is recorded. This implies that the difference between the present picture and the buffered picture is calculated by the CPU 2301 and the calculated difference is stored in the main storage unit 2302. During the reproducing operation, a video image of an
10 object to be recorded is formed by adding/subtracting the differences between the all recorded objects from a certain time instant to the present time instant.

The video data at a time instant "t" which have been recorded in the above-described manner, is displayed
15 with the sequential steps as indicated in Fig. 38. The step 3001 designates an index 2821 and a time instant "t" of video data. It should be noted that the designation of the video index is carried out by the work station 2103, whereas the designation of the time instant "t" is
20 performed by either the work station 2103, or the CPU 2301 employed in the video/audio recording unit 2108. In case that the video at the time instant "t" is not recorded as represented in steps 3002 and 3003, the video/audio recording/reading unit 2304 reads out the
25 video data which has been acquired at a time instant "s" which corresponds to the nearest time instant to the time instant "t". At the step 3004, if the video data corresponds to such data that the video information has been

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When a reproduction instruction for designating
15 a reproducing direction and a reproducing speed is sent
from the work station 2103, the CPU 2301 within the
video/audio recording unit 2108 sets forward display time
data "t" owned therein in accordance with the following
formula:

20 where symbol "w" indicates a video reading speed at the
standard reproducing speed, and symbol "a" indicates a
positive value when the reproducing direction is the
forward direction, and a negative value when the repro-
ducing direction is the reverse direction, and also such
25 a coefficient that an absolute value is 2 in case of the

1 double reproducing speed, and that an absolute value is 1
in case of the standard reproducing speed. As to the
picture representation during the reproducing operation,
in case of the reproduction in the forward direction,
5 when this time data "t" exceeds the time data 2835, the
video data 2836 is sent to the work station 2103. In
case of the reproduction in the reverse direction, when
this time data "t" becomes smaller than the time data
subsequent to the time data 2835, the video data 2836 is
10 transferred. When a demand to recognize a time instance
when a picture under display is generated is issued from
the work station 2103, this time instant "t" is trans-
ferred to the work station 2103.

Under the above-described recording/reproducing
15 methods, Fig. 39 represents a process sequence for imple-
menting the first function. At a step 3101, a reproduc-
tion mode is selected by a menu. At this time, the work
station 2103 displays the control button indicated by
reference numeral 2603 of Fig. 34. At a process step
20 3102, the work station 2103 detects a sort of button by
processing an input signal from the pointing device such
as the touch panel and by checking this input signal.
At this time, in order to indicate that this button is
depressed, as indicated in Fig. 34, the depressed button
25 whose color has been changed is again displayed on the
display, and also both of the reproducing direction and
the speed are determined. At a process step 3103, a time
instant "t" when the process data to be displayed at next

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1 time is produced is determined based on the determined
reproducing speed and reproducing direction.

As a concrete example, there are two methods as
follows:

5 (1). An interrogation is issued to the video/audio
recording unit 2108 as to the time instant "t" when the
video and audio data under display have been recorded.

(2). A time instance "t" indicated by the below-
mentioned formula is used as a time instance to be
10 represented at next time:

$$t = t + a * v,$$

where symbol "v" denotes a time period for rewriting all
data being displayed one time, and symbol "a" indicates a
positive value when the reproducing direction is the
forward direction, and a negative value when the repro-
15 ducing direction is the reverse direction, and also such
a coefficient that an absolute value is 2 in case of the
double reproducing speed, and that an absolute value is 1
in case of the standard reproducing speed. It should be
understood that since the data rewriting time period is
20 varied by other loads given to the computer, the method
(1) is also combined. Since this method is employed, a
time period of the next display information may be led by
such a leading time period equal to a time period during
which the video information and the audio information are
25 displayed by the work station 2103.

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1 At a process step 3104, a judgement is made as
to whether or not the process data to be displayed at the
time instant "t" are satisfied with the data buffered in
the work station 2103, and if these process data are
5 satisfied, then these process data are displayed. This
satisfied case implies such a case that the process data
at the time instant "t" have been buffered, or although
there was no data at the time instant "t", the data
before/after this data has been buffered. When only the
10 data before/after this data has been buffered, the data
very close to the time instant "t" is used to substitute
the process data, or data is newly produced by linearly
interpolating the data before/after this data. If the
data is not satisfied, at a process step 3105, the work
15 station 2103 determines a range for reading data as the
display data from the database 2104 based upon the
display speed and the display direction. At a process
step 3106, both of a sort of process data to be displayed
and a range of data to be read are sent via a LAN to the
20 database 2104, and the process data requested from the
database 2104 is transferred to the work station 2103.
At a process step 3107, the video and audio information
is displayed or outputted, and at a process step 3108, at
the work station 2103, the respective sent process data
25 is displayed together with the video information and the
audio information in a form of a trend graph, or a meter
under display manners of the process data stored in the
main storage 2202.

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1 Referring now to Fig. 29 to 34 and Fig. 40, a
second function will be described. The time cursor 2503
is movable in right/left directions by moving a finger in
the right/left directions while depressing the cursor
5 2503 by the finger with employment of the touch panel
2107. At this time, as shown in Fig. 40, the time cursor
2503 in the trend graph 2403 is directly moved at time
when an operator wish to refer, so that a time cursor
3201 within another trend graph 2403 is moved to a time
10 instant indicated by the time cursor 2503, and a picture
at a time instance determined by the time cursor 2503 is
called and then displayed in the video display region
2402. At this time, the meter 2405 and the like in Fig.
30 represent data about the time instant indicated by the
15 time cursor 2503. A designation of a time instant which
is not presently indicated on the time axis of the trend
graph 2403 may be done by employing the time axis moving
buttons 2506 and 2507. As previously described, by
designating the place to which the process data under
20 representation is wanted to be referred, both of the
picture at the time instant when this process data is
recorded and other process data at this time instant may
be referred. As a consequence, an operator directly
designates the time instant when the process data is
25 wended to be referred, while observing the trend graph
2403, so that the picture can be displayed.

As a consequence, the concrete conditions of
the field may be referred by referring the process data.

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1 A reading method of this example will now be
described with reference to Fig. 41. An algorithm shown
in Fig. 41 has such different points, as compared with
the algorithm of Fig. 39, that a time instant "t" denoted
5 by the time cursor is detected at a process 3301, and
also a judgement of a process 3302 is made as to whether
or not the time instant "t" has been previously buffered
within the work station 2103. At the process 3301, the
coordinate value of the input signal by the pointing
10 device such as the touch panel and the like is processed
by the CPU 2201 in the work station 2103, the time cursor
2503 is again drawn on this coordinate system and also
the time instant denoted by the time cursor 2503 is
calculated from the coordinate value. If the data at the
15 time instant "t" is not buffered within the work station
2103, the sequential steps 3105 and 3106 defined in the
preferred embodiment 1 are carried out, and then the
data, video and sound are displayed at the sequential
steps 3106 and 3107.

20 A third function will now be described. As
represented in Fig. 42, after a data item 3401 in a data
item display unit within a trend graph 2403 has been
selected by employing the touch panel 2107, a data value
cursor 2505 is brought to a value to be searched, whereby
25 a search value is determined. At this time, when the
selected data has a value indicated by the data value
cursor 2505, the time cursor 2503 is moved, and the time
cursor 3402 is moved at this time in another trend graph

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1 2403, so that a picture at this time is displayed on the
video display unit 2402. Also at this time, data about
the time instance denoted by the time cursor 2503 is
represented on the meter 2405 shown in Fig. 32. Here,
5 the search operation is carried out only once in a
reverse direction with respect to the time axis.
Furthermore, if another search operation is wanted, the
search operation is performed in the reverse direction by
depressing the time axis moving button 2506. On the
10 other hand, when the search operation is performed along
a forward direction, the search operation is carried out
by depressing a button 2507 along the forward direction.
As previously stated, with respect to the process data
under representation, when a value is searched, a search
15 result is displayed, and both of the picture at the time
instant when this displayed data has been recorded, and
the other process data at this time instant can be
referred.

A realizing method of this example will now be
20 described. At a process 3501, a coordinate value of an
input signal by a pointing device such as the touch panel
2107 and the like is processed by the work station 2103,
and a search value indicated by a data value cursor 2505
selected to be a searching object in a data item display
25 unit 2502 is determined. Next, at a process 3502, a
search direction, namely a forward direction search or a
reverse direction search is determined with respect to
the time axis. It is assumed, for instance, that

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1 basically, the reverse direction search is carried out
one, and furthermore when a forward direction button 2507
of a time axis moving button is depressed, the search
operation is performed in the forward direction, and also
5 when a reverse direction button 2506 of the time axis
moving button is depressed, the search operation is
performed in the reverse direction. A judgement whether
or not this button is depressed is executed by the work
station 2103. At a process 3503, a search instruction
10 containing a search object, a search value, a data
forming time instant under representation, a search
direction and the like is issued to the database 104, and
both of a search value which is discovered at a first
time and a display time are determined at a step 3504.
15 Since the subsequent steps 3104 to 3109 of the example 1,
explanations thereof are omitted.

In accordance with this function, the compari-
son and analysis can be done with employment of other
process data value and the video information, and the
20 extraordinary value which very rarely happens to occur
can be called under such a condition that certain process
data takes a constant value.

An example for the fourth function will now be
described with reference to Figs. 44, 45 and 46. In Fig.
25 44, in case that the button 2705 with the double repro-
ducing speed in the forward direction is selected when
the video information is reproduced, a time axis 2504
within a trend graph 2403 represents time in a twice

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- 1 range, process data presently displayed is adjusted with
a new time axis to be redisplayed, and also data which
has not been displayed is read out from the database, and
then is adjusted with the time axis to be displayed.
- 5 Next, a picture is displayed on the video display unit
2402 at a speed two times higher than the standard speed,
so that the time cursor 2503 is moved. As described
above, during the double speed reproduction, data about
longer time can be displayed within the trend graph 2403
10 and then the temporal variations in the data caused by
time may be observed. Such a representation is useful
for data search operation.

- On the other hand, in Fig. 45, when the button
2707 with the 1/2 reproducing speed is selected, the time
15 axis 2504 indicates time of a 1/2 range smaller than that
of the standard speed. At this time, since more precise
data can be displayed, the data which has not been
displayed during the standard speed is redisplayed
together with the data which has been previously read out
20 from the database and is present. That is to say, when
the picture is reproduced, the method for calling the
process data and the method for displaying the process
data are changed, depending upon the reproducing speeds.
As a consequence, when the reproducing speed is
25 increased, since the data with lengthy time can be
displayed on the trend graph 2403, the data search and
observation can be readily performed. If the reproducing
speed is increased while calling the process data, the

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1 time intervals between the data generation time become
long. However, the rough calling caused by this repre-
sentation is not emphasized. On the other hand, when the
reproducing speed is delayed, the data may be displayed
5 more in detail. Accordingly, when a detailed analysis is
required, the process data can be displayed more in
detail by merely reproducing the picture at the slow
reproducing speed.

As a result, since a display degree of the
10 process data with respect to the time is varied in
accordance with the reproducing speed, the load given to
the computer may be suppressed to some extent.

A realizing method of this example will now be
described with reference to Fig. 46. At a step 3102, a
15 reproducing direction and a reproducing speed for video
information and audio information are determined by
receiving an input from an operator. At a step 3801,
based upon the determined speed, a display method and a
calling method of process data are determined in the work
20 station 2103. As the display method, a display unit for
a time axis in the trend graph 2403 is determined, namely
how long a time interval is determined. As the calling
method, both of a time interval among data in a called
block, and a time length in a block which is called one
25 time are determined. When the data buffered in the step
3104 is not sufficient, the time interval and the time
length which have been determined at the step 3105 are
coded and then are transferred to the database. In the

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1 database, based upon the codes sent at the step 3105, the
block data about the time interval and the time interval
are read out from the database and then are transferred
to the work station 2103. Subsequently, the data
5 representation is carried out based upon the predeter-
mined display method in the work station. Since this
part is the same as the steps 3104 to 3109 of the above-
described embodiment, an explanation thereof is omitted.

A fifth function will now be described. In
10 Fig. 47, as a method for displaying process data, the
time axis 2504 is reduced by 1/2 in a section 3901 of the
time axis of the trend graph 2403, the time axis is
remained in a section 3902 thereof, and the time axis is
enlarged twice in a section 3903 thereof. At this time,
15 the time interval of the generation time of the process
data to be displayed in the section 3901 becomes two
times longer than that of the section 3902, whereas the
time interval of the generation time thereof in the
section 3903 becomes 1/2 time interval of the section
20 3902. As a consequence, the same display as in the
double reproducing speed of the previous embodiment is
made in the section 3901, the same display as in the
standard reproducing speed is made in the section 3902,
and the same display as in the 1/2 reproducing speed is
25 made in the section 3903. In this case, when the
reproduction at the standard speed along the forward
direction is performed by the video controller 2603 with
using the button 2704, the picture is displayed in the

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1 video display region 2402 at the double reproducing speed
in case that the time cursor 2503 is located at the
section 3901. Also, when the time cursor 2503 is
positioned at the section 3902, the picture is displayed
5 at the standard reproducing speed; and when the time
cursor 2503 is positioned at the section 3903, the
picture is displayed at the 1/2 reproducing speed. In
other words, since the method for displaying the process
data is previously set, the reproducing speed of the
10 picture is set in conformity with this display method and
then the picture is reproduced at this set speed during
the reproduction operation.

As a consequence, not only the method for
displaying the data can be designated by the operator,
15 but also the picture can be reproduced at a slow speed
when the operator wants to observe the data in detail,
and also at a quick speed when the operator wishes to
skip the data.

As to a realizing method of this example, a
20 description will now be made with reference to Fig. 48.
At a step 4001, in response to an input by an operator,
sections of time axes to be reduced and enlarged are
designated. At a step 4002, the operator selects one of
reduction and enlargement with respect to this section.
25 These designation and selection may be performed by
using, for instance, a menu. Also, as similar to this
example, after the section is designated by way of the
touch panel, end points of this section are grasped to

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1 reduce and enlarge this section. At this time, the time
axis is again displayed at the step 4003 and also the
process data is again displayed. At this time, the work
station determined the reproducing speeds of the respec-
5 tive sections and the determined reproducing speeds are
stored in the main storage 2202. Subsequently, the
reproduction is commenced, and the display time "t" is
determined at a step 3103. After a section containing
this display time "t" has been decided, if the decided
10 section does not correspond to the previous section, a
reproducing instruction such as a reproducing speed and a
reproducing direction is sent to the video/audio record-
ing unit 2108 at a step 4004. A subsequent step of this
method is similar to the steps 3104 to 3109 of the
15 previous embodiment.

A sixth function will now be described. In
Fig. 49, when video information is reproduced, not only
process data, but also operation information instructed
by an operator are reproduced in combination thereto.
20 At this time, both of the picture and the process data
which have been displayed on the display at this time,
are represented, and furthermore an input from the
operator indicated by a mouse cursor 4101 is reproduced
and represented. At this time, as shown by 4102, a
25 picture displayed in the picture display region 2402 is
newly selected, so that video information which happens
to occur in response to the operation of the operator and
could not be seen when the recording operation was

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1 performed, can be referred. Also, the process data and
the like which were not displayed may be represented by
way of the similar operation. As a result, for example,
an extraordinary matter which happens to occur due to
5 misoperation by an operator can be quickly found out.
This may give a great advantage in an education of
control operation.

It can be recognized whether or not the
variations in the process operation conditions are caused
10 by the operation instruction of the operator by repro-
ducing the operation information of the operator. Also,
such an operation instruction is recorded and reproduced,
this operation instruction may be used to explain the
operation sequence, and to monitor the educational system
15 and also the operation conditions of the operator.

A seventh function is such that operation
information to be searched by an operator is inputted,
the inputted operation information is searched, and
operation information, video information, audio infor-
20 mation and also process data at this time are called out
and displayed. As a result, a search for information can
be done in such a way that the operation carried out by
the operator is set to a target.

Therefore, since the operation instruction by
25 the operator can be searched, the variations in the
process data and in the picture, which are caused by the
operation of the operator, can be searched.

A realizing method for the above-explained two

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1 examples will now be described. In Fig. 36F, the data
2850 indicates screen information recorded in the
database 2104. The screen information 2850 is arranged
by a time instant 2851, a title of a camera 2852 for
5 imaging a picture to be displayed on the moving picture
display region 2202; titles of process data 2853 to 2855
displayed in a trend graph 2403, and titles of data being
displayed in a meter 2405 and other data display units.
This data is transferred from the work station 2103 to
10 the database 2104 when the operator selects the pictures
to be displayed in the moving picture display region
2402, changes, adds, or deletes the data to be displayed
in the trend graph 2403.

A data structure of operation data inputted by
15 an operator is identical to the data structure 2820 of
the process data of Fig. 36B. It should be noted that
instead of the process data value 2824, the operation
instruction inputted as the operation data (namely, an
instruction produced by processing a coordinate value
20 inputted by the operator with employment of a pointing
device in the work station 2103) is entered. This data
is also sent from the work station 2103 to the database
2104 at a time instant when the operation instruction is
issued.

25 As to the reproduction, a reproduction
algorithm is the same as the algorithm indicated by Fig.
39. It should be noted that although the process data
has been produced at the step 3108 by selecting the data

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1 very close to the display time "t", or interpolating the
preceding data and the succeeding data, the execution of
the operator operation data is effected when the display
time "t" exceeds the recording time of the operation data
5 during the forward reproducing direction, and when the
display time "t" is less than the recording time of the
operation data during the reverse reproducing direction.
The contents of the screen information data recorded at
the time instant 2851 is represented when the display
10 time "t" exceeds the time instant 2851 during the forward
reproducing direction, or when the display time "t" is
less than the time instant 2857 during the reverse
reproducing direction.

As to the search operation, a search algorithm
15 is the same as the algorithm shown in Fig. 43. It should
be noted that after the display time "t" has been deter-
mined at the step 3504, the screen information data very
close to a time instant before the display time "t" is
first called out at a step 3506, and thereafter process
20 data to be displayed is determined and then is called out.

The following examples describe relating
representations of video and process data when video,
audio and process data are reproduced in all of the
above-described embodiments.

25 An eighth function is such that in Fig. 50, a
window of a boiler displayed in the moving picture
display region 2402 is defined as a selecting object
4201, when this object is selected, a graphics for

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1 indicating that this selecting object is selected is
represented, and also a title of process data 4202
produced therefrom is represented in the process data
item in the trend graph 2403, and furthermore the process
5 data 4203 is displayed as a graph. As described above,
the related process data is displayed by selecting the
selecting object within the picture with employment of
the pointing device. It should be noted that the
selected object is not the window of the boiler, but the
10 window may be previously registered as the selecting
object in the controlling computer. Although the data
may be displayed in the meter 2405 other than in the
trend graph 2403, for the sake of simplicity, only such a
case that the data is displayed in the trend graph 2403
15 will now be described.

A ninth function is such that in Fig. 51, an
upper pipe of a boiler displayed in the moving picture
display region 2402 is defined as a selecting object
4301, when this object is selected, a graphics for
20 representing that this selecting object is selected is
represented, in case that process data 4302 related to
this selecting object corresponds to a vapor pressure
which has been previously displayed in the trend graph
2403, vapor pressure 4302 of the process data item is
25 highlighted and also a graph 4303 is highlighted, which
represents the data related to the selecting object which
has been selected by the operator. In other words, when
the data about the selecting object within the selected

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1 picture was already displayed, the data is highlighted by
which the selecting object has been selected.

A tenth function is such that in Fig. 52, a
left pipe of a boiler displayed in the moving picture
5 display region 2402 is defined as a selecting object
4401, when this object is selected, a graphics indicating
that this object has been selected is represented; when
there are a plurality of process data related to this
selecting object, a selection menu 4402 located just
10 beside the selecting object within the moving picture and
containing process data as an item, is represented, and
also data is displayed within the trend graph 2403 by
selecting desirable process data for reference from the
selection menu 4402 with employment of the pointing
15 device. In other words, in case that there are plural
data related to the selecting object within the selected
picture, the selection menu is displayed from which an
operator can select desirable data to be referred.

An seventh function is such that in Fig. 53, a
20 main body of a boiler displayed in the moving picture
display region 2402 is defined as a selecting object,
when this selecting object is selected, a graphics 4501
for indicating that this selecting object has been
selected, and process data 4502 to 4504 related to this
25 graphics are displayed with being superimposed with the
corresponding moving pictures. That is to say, the
related process data is displayed at the relevant place
within the picture by selecting the selecting object

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1 within the picture with employment of the pointing
device.

5 A twelfth function is such that in Fig. 54, an
entire boiler displayed in the moving picture display
region 2402 is defined as a selecting object, when this
object is selected, a graphics 4601 for representing that
this object has been selected is displayed, temperature
distribution data related to this selecting object is
called out, and this temperature distribution data is
10 superimposed with a computer graphics 4602 on a picture
for a display purpose. The selecting object within the
picture is selected by employing the pointing device, and
a representation made by the process data with the
computer graphics is superimposed on this selecting
15 object.

20 A thirteenth function is such that in Fig. 55,
an overall boiler displayed in the moving picture display
region 2402 is defined as a selecting object, when this
object is selected, a graphics 4701 for indicating that
this selecting object has been selected is represented,
and also a graphics 4701 is displayed on a fuel supply
unit having a close relationship with this selecting
object. In other words, the selecting object within the
picture is selected by using the pointing device, so that
25 the selecting object within the picture related to this
selecting object is displayed.

A fortieth function is such that in Fig. 56, an
entire boiler displayed in the moving picture display

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1 region 2402 is defined as a selecting object, when this
object is selected, a graphics 4801 for indicating that
this selecting object has been selected is displayed, and
also additional information 4802 such as the control
5 method and the maintenance information concerning this
selecting object are read out from the database, and then
displayed on the picture. In other words, the selecting
object within the picture is selected by employing the
pointing device, and therefore the additional information
10 such as the controlling method and the maintenance
information and also the operation method for this
selecting object is represented.

As described above, based on the functions 8 to
14, the relationships between the process data and the
15 apparatuses displayed in the picture information can be
established, so that the operator can refer to the
relevant apparatus within the picture by the process
data, and also refer to the process by the apparatus
within the picture. As a consequence, for instance, even
20 if an operator has not much experience, he can simply
operate the apparatus and can monitor the apparatus while
observing the picture and the data.

Next, information is represented within a
picture with employment of process data.

25 A fifteenth function is such that in Fig. 57, a
process data item 4302 in the trend graph 2403 is
selected and this process data item 4302 is highlighted,
whereby a representation is made that this process data

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1 has been selected, and further a graphics 4301 for
indicating that a selecting object related to this
process data is present in the picture display region
2402, is displayed. In other words, a graphics is
5 displayed which indicates which selecting object has a
relationship with the process data within the picture.

A sixteenth function is such that in Fig. 58, a
process data item 4302 in a trend graph 2403 is selected,
whereby process data 5001 is superimposed on a selecting
10 object related to this process data and is displayed in
the picture 2402.

A seventeenth function is such that in Fig. 59,
a selection is made of a process data item 4302 within a
trend graph 2403, so that process data is superimposed
15 with a computer graphics 5101 on a selecting object
related to this process data, and is displayed within the
picture 2402.

With respect to the examples of the above-
described functions 8 to 16, a realizing method thereof
20 will now be described with using Fig. 60. A shape model
of a apparatus 5201 to be controlled is recorded in the
work station 2103, which is an object to be monitored.
A portion of this shape model is defined as a selecting
object for receiving an input from an operator. This
25 shape model may be such a mere rectangular region which
has been defined by 3-dimensional data such as a CAD
model, a process design drawing, or an image obtained
from the camera 2110, which is observed by an operator.

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1 To determine a position and a size of this selecting
object within a picture, view angle information, vertical
angle information, and horizontal angle information
derived from the ITV camera 2110 are recorded together
5 with a time instant in the database 2104. Alternatively,
based upon the camera control command to be transferred
to the ITV camera and the initial set of the ITV camera,
the view angle information, vertical angle information
and horizontal angle information are calculated by the
10 CPU 2201 in the work station 2103, the calculation result
is sent to the database 2104 and then is recorded
together with the time instants. Since the ITV camera
and the apparatus to be controlled are not moved, the
position and the dimension of the selecting object within
15 the image can be recognized by combining the initial
position of the camera, the camera information to be
recorded, and the shape model.

The ITV camera 2110 for imaging the process
apparatus 5201 forms images 5202 to 5204 by giving the
20 vertical angle information 5211, the horizontal angle
information 5212 and the zoom values thereto. Here,
images of the process apparatus 5201 displayed on the
respective pictures are 5202, 5206 and 5207, depending
upon the zoom values. A scaling operation of the
25 selecting object inside the computer is carried out in
accordance with the respective zoom values. If a simple
rectangular region is employed as the selecting region, a
selecting object corresponding to the image 5202 is 5208,

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1 a selecting object corresponding to the image 5203 is
5209, and also a selecting object corresponding to the
image 5204 is 5210. Since the scaling operations are
linear, these scaling operations can be readily carried
5 out.

With respect to such a defined selecting
object, when either a selection is made from an operator,
or any message command is transferred from other select-
ing object, such a definition has been made to initiate
10 operations that the selecting object is displayed and the
related data is issued.

A data structure of this selecting object is
indicated by data 286 shown in Fig. 36G. Reference
numerals 2861 and 2862 show a size of the selecting
15 object, reference numerals 2863 and 2864 indicate a
position, and reference numeral 2865 indicates an ope-
ration which is initiated when being selected by an
operator, or into which a pointer or the like to an
operation table is entered, and also relevant text
20 information is inputted into 2866. As a consequence, the
apparatuses within the picture can be related to either
the process data, or the related information. Also, a
relationship among the apparatuses within the picture can
be established. Furthermore, the process data and the
25 selecting object are merely displayed, but also a pre-
defined instruction may be executed when a selection is
made.

As described above, the process data can be

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1 displayed on the apparatus in the picture, and an
operator can observe both of the moving picture and the
process data without moving his eyes. Also, this is
represented as a computer graphics, so that an operator
5 can intuitively judge a data value. It can be avoid to
record useless pictures or a back scene within a picture
which is not continuously required to be recorded, by
setting a condition of picture recording time. Thus, the
video, audio and process data are reproduced in synchro-
10 nism with each other, so that the process conditions can
be more easily grasped and the extraordinary cases can be
quickly found out.

A direct operation can be achieved by selecting
the process data to which the operator wishes to refer,
15 from the picture, or directly selecting such a picture
from the process data display unit. As a result, the
monitoring characteristic, operability and reliability of
the process can be improved. Furthermore, the process
data with employment of the video data can be searched,
20 and the video data with employment of the process data
can be searched.

The above-described 8th to 17th functions can
be realized as the same realizing methods as to not only
the sound and the picture which have been recorded, but
25 also the sound and the picture which are inputted in real
time. At this time, the control data to be displayed
corresponds to data which is actually acquired. The
image selections are carried out by selecting the ITV

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- 1 cameras, or by remote-controlling the ITV cameras to pan,
or zoom the cameras.

As previously described, the present embodiments have the following advantages.

- 5 (1). Preview when process data values are set.

A preview can be performed by searching/displaying the video and process data from the past data to check how the process is going when an operator sets the process data to a certain value.

- 10 (2). Comparison in operation monitoring.

The condition of the process can be grasped by comparing the operation state of the monitoring process with the video for imaging the recorded operation state, the audio, and the process data.

- 15 (3). Determination on process data set value.

To set a certain process data value to a desired value, a related data value must also be set. As described above, when a plurality of data values are needed to be set, a determination policy of the set value
20 can be given to an operator by referring to the past data, video and audio data.

- (4). Search and analysis of extraordinary matter.

The search of the extraordinary case and the detection of the malfunction area can be effectively
25 performed by using the synchronizing reproduction of the past process data, video and audio.

- (5). Educational Simulation.

An operation manual of an operator may be

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1 employed as an educational simulation by reproducing the
operation manual.

It should be noted that although the time is
recorded in order to synchronize the measured data with
5 the video data, or the audio data in this embodiment, the
present invention is not limited thereto. For instance,
a serial number is attached to the measured data and the
video data or the like, and then the measured data may be
synchronized with either the video data, or the audio
10 data under condition that this serial number is used as
the keys.

With respect to the reproduction of the video
data, or the audio data, the reproducing speed is
increased or delayed in the above-described embodiments,
15 but the present invention is not limited thereto. For
example, as the reproducing method, the video data or the
audio data may be stationary (paused). As to this sta-
tionary method, a method by an operation of an operator
may be employed, or an alarm is previously recorded, and
20 the video data reproduction may be stopped when the alarm
happens to occur. At this time, there is such a merit
that the screen when the failure happens to occur can be
quickly searched if the reason of this failure is
analyzed.

25 Furthermore, the present embodiment is not only
directed to the moving picture by the above-described ITV
cameras, but also may process a still picture by a still
camera.

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- 1 According to this embodiments, it is possible to provide a monitoring system capable of reproducing the measured data in synchronism with the video or sound information.

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